A Dissertation on

A CLINICAL STUDY ONFOCUSSED ABDOMINAL SONOGRAPHY IN TRAUMA

VS

CONTRAST ENHANCED COMPUTERISED TOMOGRAPHYIN BLUNT INJURY ABDOMEN

BY

Dr. D.BALAJI

Dissertation submitted to

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in partial fulfilment of the regulationsfor the Award of the degree of

M.S. (General Surgery)

Branch – I

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DECLARATION

I, Dr D.BALAJI, hereby declare that this dissertation, entitled “Study OfFocussed Abdominal Sonography In Trauma Vs Contrast Enhanced Computerised Tomography In Blunt Injury Abdomen” is prepared by me guided by my Prof.P.RAMANUJAM., Professor, Department of General surgery, Madras Medical College,chennai. This Dissertation is submitted toTamil Nadu Dr.M.G.R.Medical University in partial fulfillment of university regulations for award ofM.S. Degree in general surgery during the year 2013This dissertation is not submitted in part or full to any other University by me for the award of any other degree.

Date: **Dr. D.BALAJI**

Place: Chennai PG in General surgery,

MMC,chennai

CERTIFICATE

This is to certify that this dissertation entitled "Study Of Focussed Abdominal Sonography In Trauma Vs Contrast Enhanced ComputerisedTomography In Blunt Injury Abdomen" has been prepared by Dr. D.BALAJI, Post Graduate Student in General Surgery, under my guidance and supervision at Madras Medical college, Chennai, in partial fulfillment of regulations of TamilnaduDr M.G.R. Medical University,Chennai. for the award of M.S. Degree in general surgery for the year 2013

Date: 30 -11-2009

Place: Chennai

Dr.P.RAMANUJAM

Professor of General surgery,

MMC, Chennai

CERTIFICATE

This is to certify that this dissertation entitled“ Study Of Focussed Abdominal Sonography In Trauma VsContrast Enhanced Computerised Tomography In Blunt Injury Abdomen ”is a bonafide work of Dr D.BALAJI and has been prepared by himunder the guidance of Prof. Dr.P.RAMANUJAM,Professor of General Surgery, in partial fulfillment of regulations ofTamilnaduDr M.G.R. Medical University, Chennai for the award of M.S. Degree in General Surgery for the year 2013.

DR.S.DEIVANAYAGAM,	Dr.V.KANAGASABAI
Professor of General surgery ,	**Dean,**
M.M.C.,CHENNAI.	M.M.C., CHENNAI
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Date: 30-11-2009

Place: CHENNAI **Dr.D.BALAJI**

INTRODUCTION

Blunt Abdominal trauma is one of the most common causes among injuries causedmainly due to road traffic accidents. The rapid increase in number of motor vehicles and its aftermath has caused rapid increase in number of victims to blunt abdominal trauma. Motorvehicle accidents account for 75 to 80 % of blunt abdominal trauma.

Blunt injury of abdomen is also a result of fall from height, assault with blunt objects,industrial mishaps, sport injuries, bomb blast and fall from riding bicycle.Blunt abdominal trauma is usually not obvious. Hence, often missed, unless,repeatedly looked for. Due to the delay in diagnosis and inadequate treatment of theabdominal injuries, most of the cases are fatal. The knowledge in the management of bluntabdominal trauma has progressively increasing . In spite of the best techniques and advancesin diagnostic and supportive care, the morbidity and mortality remains at large. The reason forthis could be due to the interval between trauma and hospitalization, inadequate and lack ofappropriate surgical treatment, delay in diagnosis, post operative complications and associatedtrauma especially to head, thorax and pelvis .

In view of increasing number of vehicles and consequently road traffic accidents, thisdissertation has been chosen to study the cases of blunt abdominal trauma with reference tothe patients presenting at Rajiv Gandhi government general hospital,attached to Madras Medical College, Chennai.

AIM OF STUDY

Table: 1

AIM OF THE STUDY	To study the sensitivity of FAST in comparision with CECT in blunt injury abdomen patients
Objectives	To study the sensitivity of FAST in comparision with CECT in blunt injury abdomen patients
Study Design	Prospective study
Inclusion Criteria	1. All blunt injury abdomen 2. patients who needed laparotomy
Exclusion Criteria	1. Patients who are managed conservatively 2. Associated head injury 3. Chest injury 4. Any patient who declined to participate in the study.

REVIEW OF LITERATURE

Selective history

Blunt injury as causes of intra abdominal injuries have been recognized since historical times.

Aristotle was the first to record visceral injuries from blunt trauma. Hippocrates and Galen are said to have given apt description of the condition.

By 1500 BC distinct triage and surgical protocol had been developed in Babylonia under the rule of Hammurabi as said by Edwin Smith Papyru.

The ancient Chinese used a sharp blow on the region of the spleen as a method of assassination.

Trausse in 1827 presented fracture of body of pancreas in blunt trauma Von ReckilingHusendescribed artery thrombosis occurring as a result of blunt trauma.

In 1906 Solomen performed Peritoneal lavage for the first time.

In 1934 Aenhium used puncture of abdominal wall as a diagnostic procedure in abdominal injuries. Branch in 1938 reported 2 cases of liver laceration treated by resection of left lobe.

Synthetic grafts was first used by Voorhes in 1952 and widely employed by Hughes (1954) and Spencer (1955).

The development of emergency medical service is an important milestone in the history of clinical and surgical practice of trauma. Greeks required physicians to be present during the battle and Romans established the hospitals close to the battlefield.

Cincinnati General Hospital first instituted the ambulance system in 1865.

Advanced imaging techniques like spiral CT scan and MRI has made early detection of blunt abdominal injuries easier.

Anatomy of abdominal cavity:

Abdominal cavity extends just below xiphisternum to deep into the pelvis. It has number oforgans, some solid and other hollow viscus. Abdominal organs are protected anteriorly onlyby muscles except those organs/parts lying under the lower ribs and in the pelvis. Theabdominal cavity is bounded anteriorly by the rectus abdominis, laterally by external, internaland transverse abdominis and more inferiorly, the iliac muscles and posteriorly by thevertebral columns and psoas major, minor and quadratuslumborum .It is divided into nine regions for the descriptive purpose by two horizontal lines andtwo vertical arbitrary lines. The horizontal lines are transpyloric, at the level of pylorus ofstomach or passes through the tip of the ninth costal cartilage and that passing through theintertubercles of the ilium as transtubercular line. The two vertical lines are from midclavicledownwards. The resulting quadrants are right and left hypochondriac, middle epigastric, rightand left lumbar, middle umbilical, right and left iliac, middle hypogastric.Mid, right and left zones, Zone 1 (upper thorax), zone 2 (lower thorax), zone 3(abdomen)

Peritoneal cavity:

The peritoneum lines the wall of the abdominal cavity. It is a serous membrane.Developmentally abdominal and pelvic viscera invaginate into the abdominal cavity carryingthe peritoneum before them. T The layersof opposing peritoneum between viscera and body wall and between two organs for visceralligaments of the abdominal cavity.The disappearance, fusion, shifting, shortening of theseperitoneal folds during development divides the peritoneal cavity into two distinct parts, thegreater and lesser sac. The lesser sac is situated posterior to the lesser omentum, stomach andgastro colic ligament. Right side, it communicates with the greater sac through the foramen ofwinslow . The structures within the abdominal cavity which are not suspended from the body wall by the mesentery or the ligaments are retroperitoneal in position. In malesperitoneal cavity is a closed cavity, whereas in females it communicates with the exteriorthrough the openings of the fallopian tube at the fimbrial end.

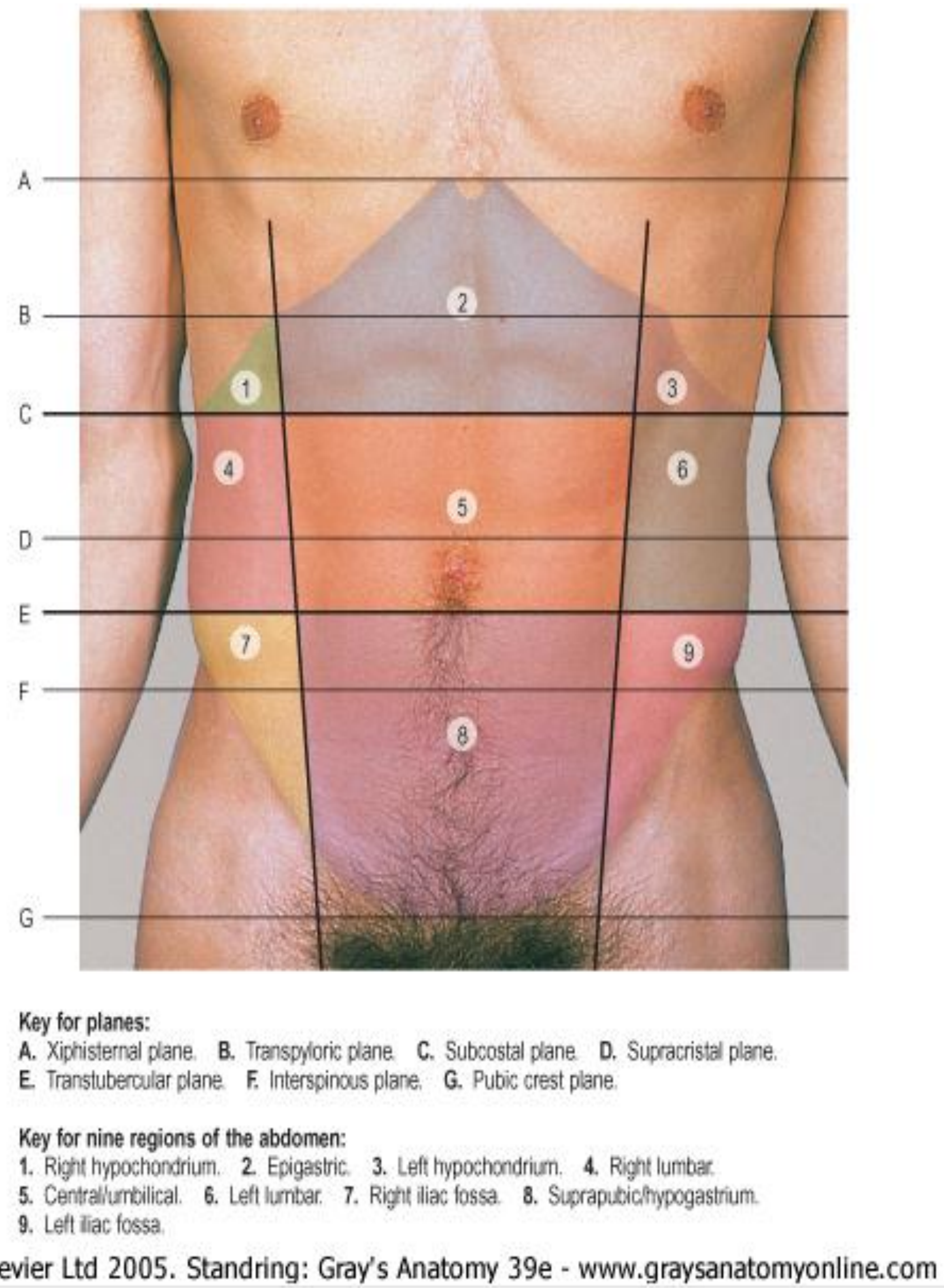


Fig 1: Different quadrants of abdomen

Solid organs:

Liver:

The liver is situated in the right upper quadrant of the body. It is wedge shaped; the base of the wedge is directed to the right. It is the largest gland in the body. The anterior surface is triangular and is related to the xiphoid process and the diaphragm on either side. The superior surface is quadrilateral and is marked by the cardiac impression in the middle. The diaphragm separates it from the pericardium and heart in the middle and from the pleura and lungs on each side. The inferior surface is also quadrilateral and has a sharp border. The liver has two lobes. Right lobe, which has two additional lobes, the caudate and quadrate lobes. Left lobe on the inferior surface presents the omental tuberosity. It is held in position by various ligaments such as falciform ligament, ligamentumteres, anterior and posterior layers of coronary ligament and right and left triangular ligaments. Liver receives 20% of its blood supply from the hepatic artery, and 80% from the portal vein. Before entering the liver, the hepatic artery and portal vein divide into right and left branches. Venous drainage is from the hepatic veins, which drain directly into the inferior vena cava. common bile duct and drains into the second part of duodenum.

Spleen:

Spleen lies in the left hypochondriac region of the abdomen, its long axis being parallel to that of 9 rib, behind the stomach and inferior to the diaphragm. It is a lymphatic organ connected to the vascular system. It is surrounded by the peritoneum and is suspended by the following ligaments.

a) Gastro-splenic ligament from hilum to the greater curvature of stomach.

b) Lienorenal ligament from the hilum to the anterior surface of left kidney.

c) Phrenicocolic ligament supports the anterior end of the spleen. Splenic artery, a branch of coelic artery, supplies it.

Pancreas:

Pancreas lies obliquely on the upper part of the posterior abdominal wall extending from the concavity of the duodenum to the spleen at the level of L1 and L2 vertebra. It is an elongated organ which has both exocrine and endocrine functions. Anterior ly, it is related to transverse colon and stomach. Posteriorly, to the aorta, inferior venacava, superior mesenteric artery and the left crus of diaphragm. The tail of the pancreas is related to the hilum of spleen.

Kidneys and suprarenal:

Kidneys are a pair of excretory organs situated on the posterior abdominal wall one on each side of the vertebral column behind the peritoneum. The right kidney is slightly lower than the left, and the left kidney is a little nearer to the median plane than the right. Each kidney has got two poles, two borders and two surfaces. Upper pole is broad and is related to suprarenal gland, the lower pole is pointed. Lateral border is convex; the medial is concave, with hilus in the middle. Anterior surface is irregular and posterior surface is flat. Right kidney is related to right suprarenal gland, second part of duodenum, hepatic flexure of colon and small intestine. The left kidney is related to left suprarenal gland, spleen, stomach, pancreas, splenic vessels, splenic flexure, descending colon and the jejunum. Posterior surface of both the kidneys are related to diaphragm, medial and lateral arcuate ligaments, psoas major,

quadratuslumborum, transverse abdominis, subcostal vessels and the subcostal, iliohypogastric, and ilioinguinalnerves. In addition, the right kidney is related to 12th rib, and the left kidney to 11th and 12thribs. Renal fascia (fascia of Gerota) is the fibroareolar sheath surrounding the kidney and perirenal fat. Renal artery and vein supply kidneys. Renal artery is a direct branch of aorta; renal vein drains directly into the inferior venacava.

Adrenal gland

The adrenal glands are infrequentlyinjured by blunt trauma. They lie close to the middle of the upper abdomen and are protected by the spine, ribs, and major organs. Adrenal injury has been reported in 28% of patients with moderate abdominal injury studied at autopsy.Hematoma in adrenal is seen as a round orovoid mass. High densityStrandsalso represent hemorrhage may be seen in the perirenal fat. Initially the Hematoma in adrenalmay demonstrate an increased density. As time progress the density decreases as the blood clot lyses. In large no of patients the hematoma will be reabsorbed, but occasionally it will persist to form aseroma. This will be the most common cause of adrenal pseudocysts. In most patients, adrenal injury has little significanceclinically. The quantity of blood loss is large and more than 90% of functioning adrenal tissue must be lost before the patient becomes adrenal insufficient. However, if bilateral hematoma in adrenal occur, the potential for developing Addison's disease must be considered.

INTESTINAL INJURY :

The intestine with or without external wound can be ruptured, this was well known fact since the
time of Aristotle who quoted slight blow to abdomen can cause intestinal rupture without injury to the skin.

Injuries of small bowel comprise about one quarter of blunt and penetrating abdominal trauma. Mortality rates have steadily decreased and are directly proportional to the number and severity of associated injuries as well as time between injury and treatment. These injuries were classified according to organ injury scale described by theAmerican association for Surgery of Trauma based on laparotomy. Increased morbidity results from delayed presentation or massive leakage of bowel contents into the peritoneal cavity.Diagnostic CT findings considered for bowel injury are contrast extravasation and/or extraluminal air. Findings which are non-diagnostic but suggestive are; free fluid without solid organ injury, small bowel thickening and dilatation.Peritoneal fluid with no visible solid organ injury is an important sign of bowel injury; this finding has been replicated in several studies.CT diagnosis for small bowel perforation has a sensitivity of 92% and specificity of 94%the proximal jejunum and distal ileum were more prone to perforation.The small intestine is more frequently injured than the colon and perforation in the anti mesenteric border of the small intestine is the commonest injury. Associated injuries are often the factors determining survival.Isolated Rupture of the Duodeno-jejunal junction can occur. Perforation are more common in the proximal jejunum or distal ileum.

Retroperitoneum

It is often difficult to diagnose the injuries to the retroperitoneum, especially in the presence of other injury, as the physical signs may be masked. Intraperitoneal diagnostic tests such as ultrasound and diagnostic peritoneal lavage may be negative. The computerized tomographic scan is the investigation of choice in such patients. The only limitation is that the patient should be physiologically stable. The retroperitoneum can be divided into three zones (Figure 1)

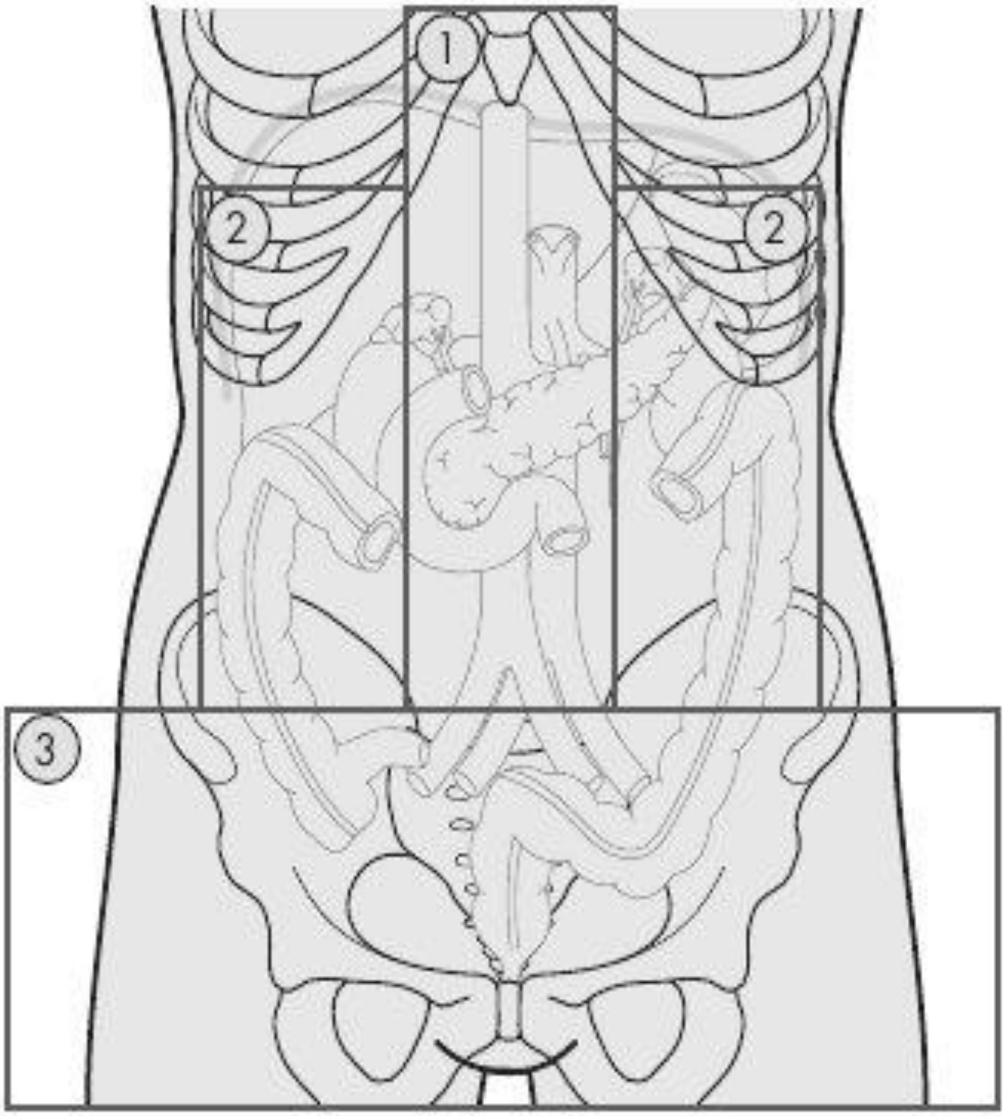


Fig 2: Zones of the retroperitoneum

Zone 1 (central):

Central hematomas in this zone should always be explored, with proximal and distal vascular control.

Zone 2 (lateral):

Lateral hematomas in this zone usually represent a renal injury and this can be managed non-operatively and sometimes with angioembolization.

Zone 3 (pelvic):

It is very difficult to control a pelvic hematoma and it should not be opened unless required. They can be controlled with intra or extra pelvic packing or angioembolization.

Experience along with investigation have been the most important in determining the use of diagnostic methods.

Pathophysiology:

Several pathophysiological processes take place in a case of blunt abdominal injury. Understanding the mechanisms of injury is crucial in the management of a patient with blunt abdominal trauma. In general; injuries can be classified as high energy or low energy.

Mechanisms of Injury

Blunt trauma

Compression or crushing

Solid and hollow organs

Burst injuries

Shearing

Deceleration – fixed points

1. Compression of abdominal organs between the applied force to the abdominal wall and the posterior thoracic cage of the vertebral column can produce a crush injury.

2. Abrupt shearing forces can cause a tear of organs or vascular pedicles.

3. Oblique forces and deceleration injury cause shearing of viscera where anchored, such as at the duodenojejunal flexure and peritoneal attachments of the bowel.

4. Deceleration injuries occur in high speed vehicular accidents and in falls from great heights. On impact, the organs continue to move forward at the terminal velocity, tearing the organs at their sites of attachment.

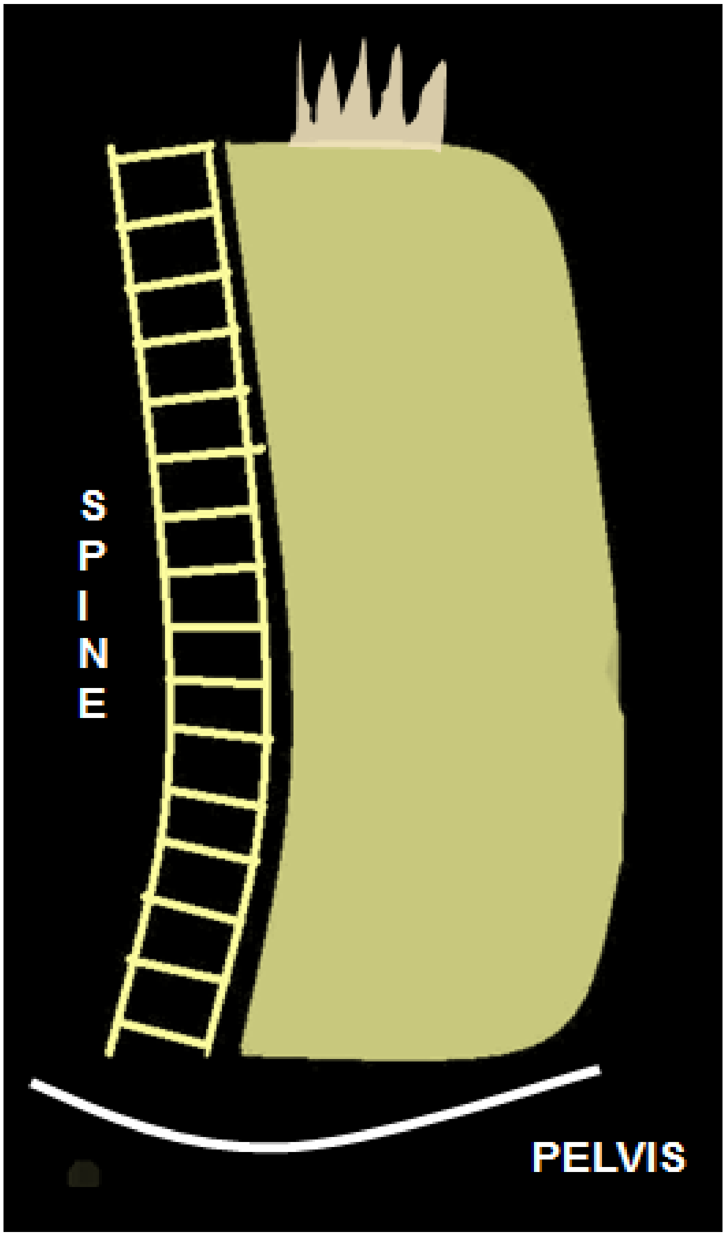
Mechanisms of Injury – Indirect evidence

Fracture 7- 9 ribs right side – liver

Fracture 8 -10 ribs left side – spleen

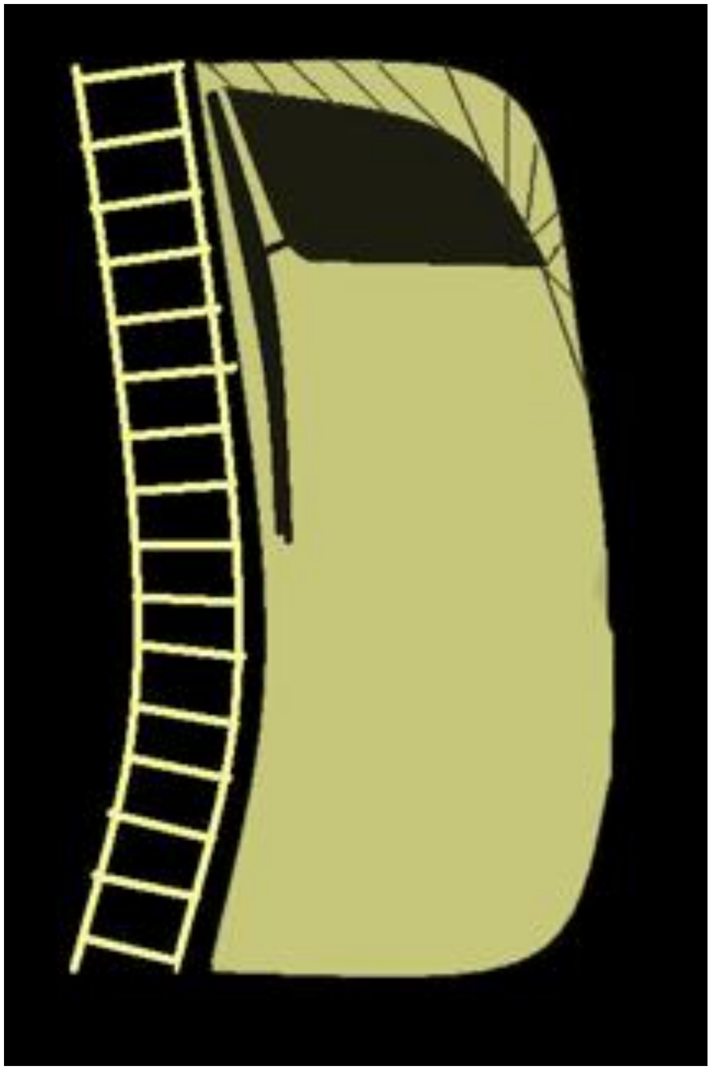
Fracture 11 / 12 ribs or haematuria – kidney

Fig 3 Showing the Pathophysiology of Blunt Abdominal Trauma in Compression or concussive forces



- direct blows or external compression against a fixed object tears and forms subcapsular hematomas to the *solid viscera* and deform *hollow organs* and transiently increase intraluminal pressure, resulting in rupture ,Severe forces may also rupture the *diaphragm*

Fig 4 Showing the Pathophysiology of Blunt Abdominal Trauma in DECELERATION FORCES



- stretching and linear shearing between relatively fixed and free objects rupture supporting structures at the junction between free and fixed segments

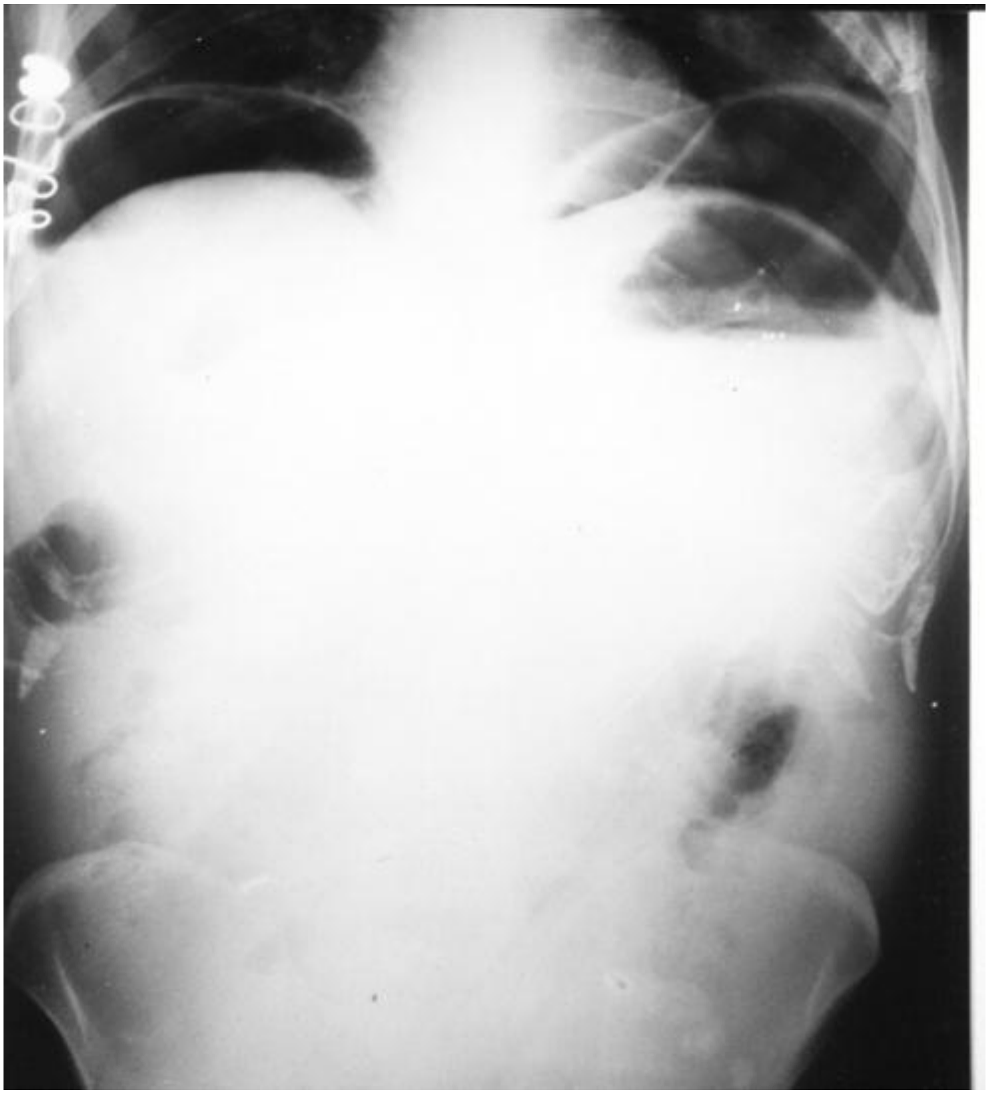


Fig 5: X ray erect abdomen showing Gas under diaphragm in Blunt injury abdomen

2. FOCUSED ABDOMINAL SONOGRAPHY FOR TRAUMA (FAST):

Focused abdominalsonographyin trauma (FAST) was familiarized in the United States by Rozycki in the early 1990s. starting and follow-up experience indicated that FAST was accurate, non-invasive, and expeditious inassessing the critically traumatised patient in the emergency room. As quality ultrasound machines have become portable there is an increasing trend of theirapplication in the initial assessment of blunt abdominal injury. The procedure can be done by surgeons as well as radiologists both of equal reliability and was particularly useful in detecting hemoperitoniumin the abdominal cavity.

Four areas imaged are:

1. **XIPHISTERNUM**
2. **RIGHT HYPOCHONDRIUM(MORRISION POUCH)**
3. **LEFT HYPOCHONDRIUM**
4. **PELVIS**

Looks only for free fluid

Sensitivity 28 – 92 %

Specificity 90 – 100 %

Negative predictive value 84 – 99 %

Solid organ injury – 44 – 91 % sensitive

<u>No free fluid does not rule out an injury</u>

Fig 6: FAST showing splenic laceration

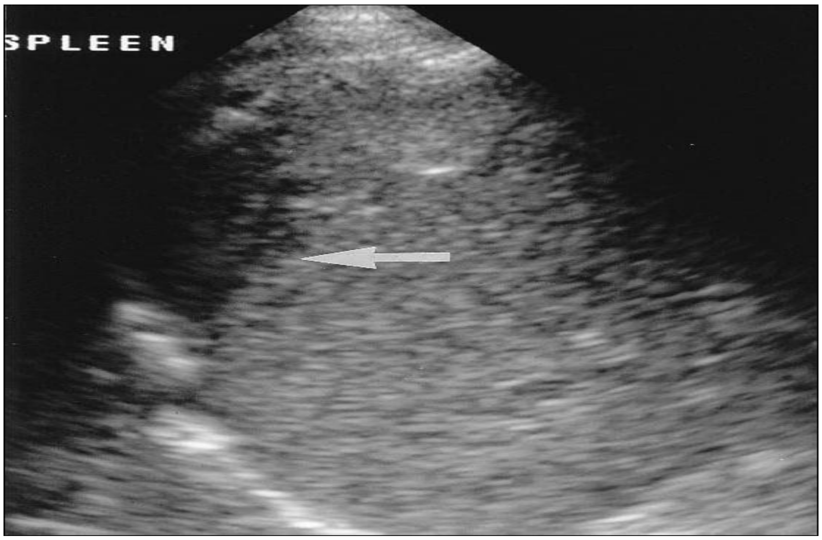


Fig 7:FAST showing liver injury

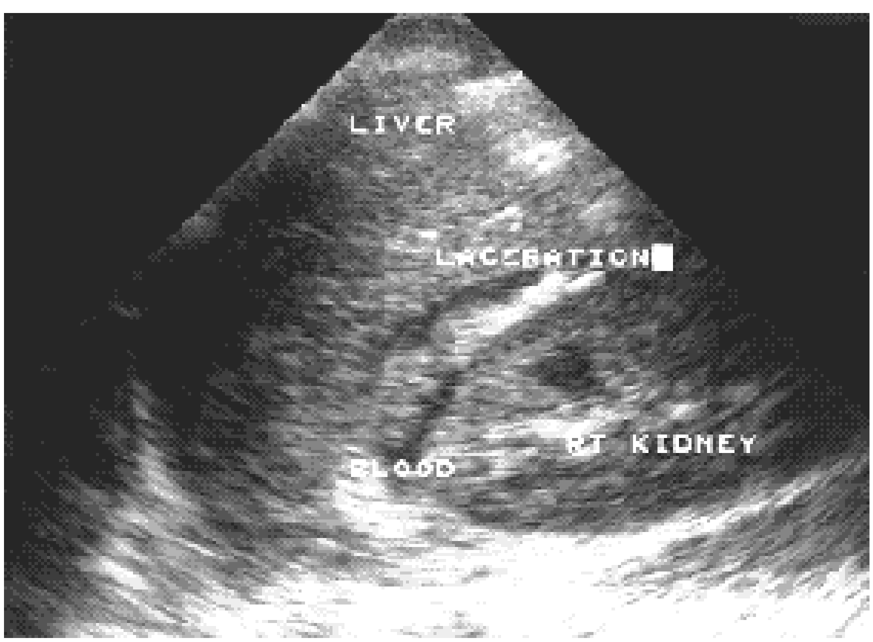


Fig 8: FAST showing renal injury with collection in Morrison pouch

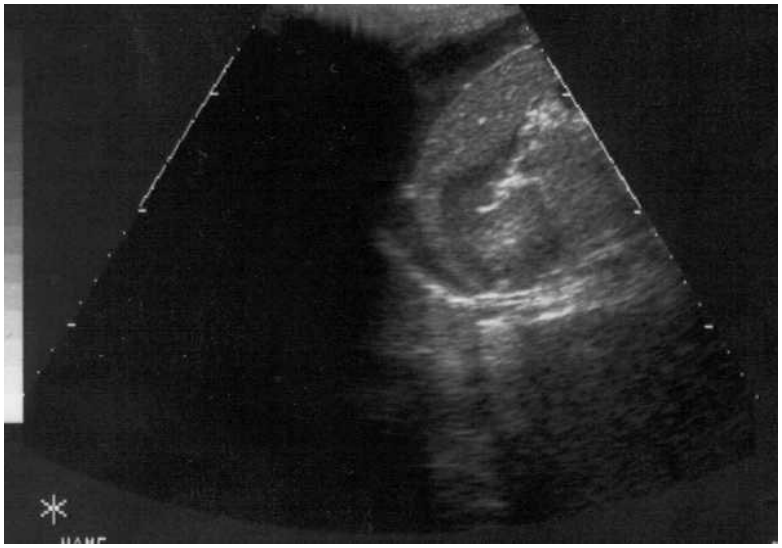
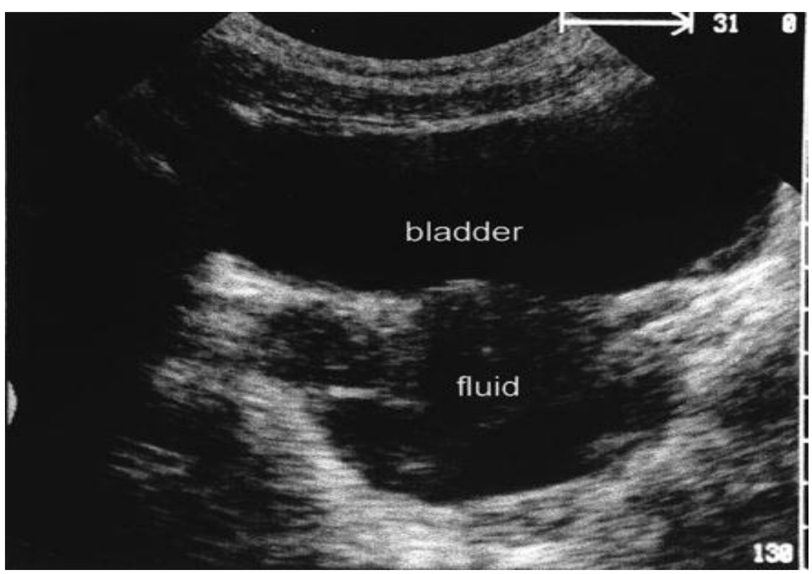


Fig.9 FAST showing a clear area of fluid can be seen just behind the bladder



The advantages of the FAST is non-invasive, may be easily carried out and done in concurrent with resuscitation. Added to, the technology is portable and may be repeated easily if necessary. In majority cases, FAST can be completed within 3 or 4 minutes. The test is useful for detecting intra-abdominal bleeding in the multiply injured or pregnant patients.

Drawback ofFAST is the fact that a positive examination depends on the presence of free intraperitioneal fluid, and is operator dependent. With most operators, ultrasound will detect a minimum of 200 mL of fluid. Injuries withouthemoperitoneum may be not detected by this modality. In addition the FAST examination is not be used to grade solid organ injuries. Therefore, in the hemo-dynamically stable patient, a follow-up CECT scan should be done if conservative management is contemplated. FAST compares favorably with most traditionally utilized diagnostic investigations. In the hemodynamically stable patient with BIA,

FAST offers a viable alternative to DPL.

ADVANTAGES: Widely available. No use of radiation or contrast media.

DISADVANTAGE: Experienced Ultrasonographer needed and observer variation.

Difficult to scan in presence of lower rib fracture, extensive skin lesions, soft tissue injuries and dressings.

3.Computarized tomography of abdomen (CECT scan):

This provides important diagnostic information on abdominal injuries.

Features of CECT:

With oral, IV and rectal contrast

Evaluate and grade injuries – decision on management

Evaluation of retroperitoneum

Indications for CT

Positive FAST – haemodynamically normal

Negative FAST with:

Pain in lower chest or upper abdomen

Fractures above and below diaphragm

Mechanism for abdominal impact

Altered mental status

Pelvic fracture

Haematuria

CECT has become the ‘gold standard’ for the intra-abdominal diagnosis of injury in a stable patient. The scan is performed using intravenous contrast and often oral contrast as well. CT is sensitive for blood and has the added advantage of sensitivity for the diagnosis of retroperitoneal injury. An entirely normal abdominal CT is usually sufficient to exclude injury. The disadvantage of CECT is the need to shift the patient to the scan room. Added, it is more costly than other investigation. CECT also grades solid organ injury, and in a stableinduvidual with positive FAST findings, it is indicated to grade organ injury and to evaluate contrast extravasation. If contrast is seenextravasating, even with low grade hepatic or splenic injuries, exploratory laparotomy or, more recently, interventional angiography and intravascular embolization are done.

Fig 10: CECT showing splenic laceration

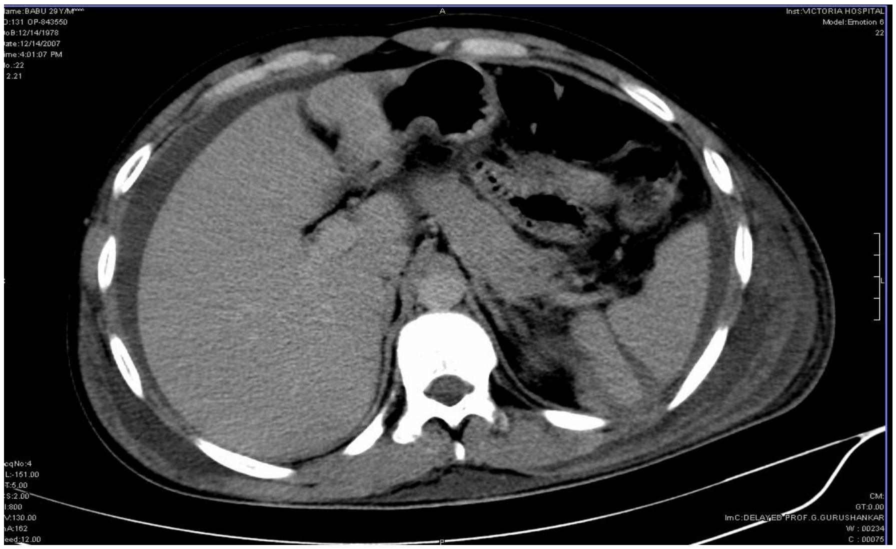


Fig 11: CECT showing liver hematoma

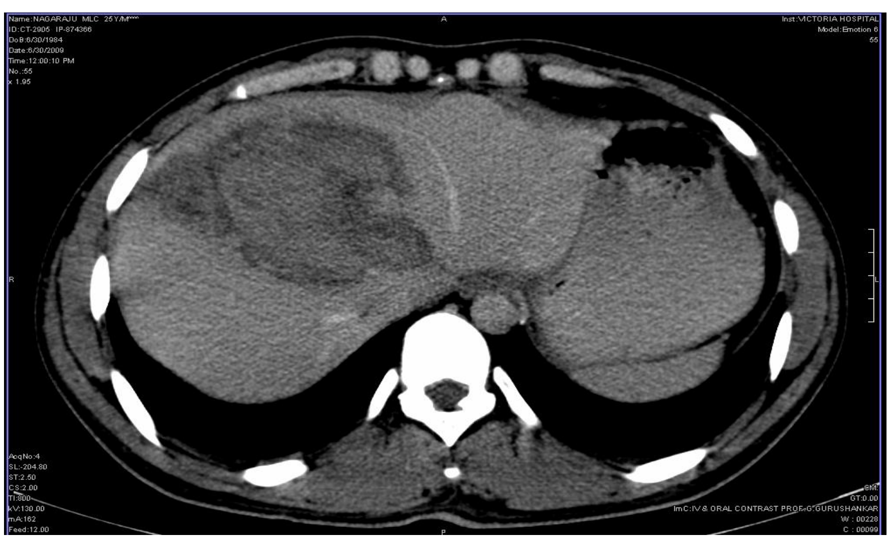
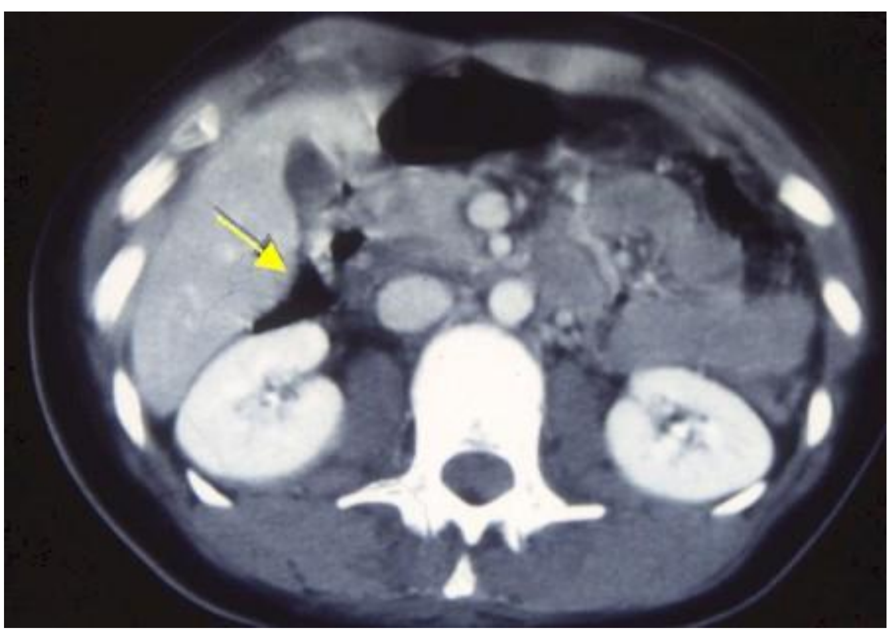


Fig 12: CECT showing right renal injury

Fig 13:CECT SHOWING DUODENAL INJURY

(Air in the retroduodenal area)



Indication for CECT is in the workup of patients with solid organ injuries initially treated conservatively who have a decreasing hemoglobin. The most important drawback of CECT is its inability to show hollow viscus injury. Usually, the presence of free intraperitoneal fluid on CECT without solid organ damage should rise doubt for mesenteric, intestinal, or urinarybladder injury and exploratory laparotomy is often indicated. One of the common intriguing problems regarding the objectively evaluating of blunt abdominal injury by CECT is what to be done when free fluid without findings of solid organ or mesenteric injury is found. Coupled with the low sensitivity of CECT to diagnose hollow viscustrauma, it creates aoscilation for most trauma surgeons. The choice are either to surgically explore all patients and accept a significant rate of negative laparotomy or to watch and "act" when peritoneal signs develop while remembering in mind that a delay in the diagnosis of bowel injury may be dangerous. A recent study in which trauma surgeons askedabout what would be the appropriate traetment of patients in this circumstance they showed a variety of responses: 42% woulddo DPL, 28 % will observe the patient, 16% would surgically do exploration, and 12 % will repeat an abdominal CECT scan. The accuracy of CECT ranges from 92% to 98 %, with low false positive and false negativity rates.Evenlthough the use of abdominal CECT for penetrating abdominal trauma has been limited because of low sensitivity in diagnosing intestine and diaphragmatic injury,modern technology (multislice spiral

CT) has been found in selected cases when conservative management is being considered. conservative management of blunt wounds to the anterior aspect of the abdomen has not been emphasized because of the low morbidity rate after nontherapeutic laparotomy.

The following points are important when performing CECT

- Despite its obvious value, it remains an inappropriate investigation for unstable patients who have a risk of rapid detoriaration while in the scanning machine.
- If duodenalsegment injury is suspected from the mechanism of trauma, oral contrast may be helpful.
- If rectal and distal colonic injury is suspected in the absence of blood on rectal examination, rectal contrast may be helpful.
- In multislice CT examinations, fat may erroneously appear to be ‘free air’.

Advantages

- Adequate evaluation of the retro-peritoneum
- conservative management of solid organ injuries
- evaluation of renal perfusion
- Non-invasive
- Highgly specific.

Disadvantages

Only in haemodynamically normal patients !!

- Trained staffs
- Hard-ware machinery
- Long time of scan: Helical versus conventional
- Hollow viscusdamage
- expensive

Future Prospects

As technology advances, evaluation of mesenteric and hollow viscus injury by CECT will be smoother. 2D and 3Dreconstructions may help in the identification of intestinal thickening, small bubbles of free air in the nearby of the area of injury, and small amounts of free fluid between loops of intestine or in the mesentery.

AAST(AMERICAN ASSOCIATION FOR THE SURGERY OF TRAUMA) **GRADING OF HEPATIC INJURY : Table 2**

GRADES OF LIVER INJURY	DESCRIPTION
I	Hematoma:subcapsular, <10% surface area Laceration: capsular tear, <1cm parenchymal depth
II	Hematoma: subcapsular, 10-50% surface area Intra-parenchymal, <10cm diameter. Laceration:1-3 cm parenchymal depth, <10cm long
III	Hematoma: subcapsular, >50% or expanding; ruptured Sub-capsular or parenchymal hematoma; Intra-Parenchymal hematoma >10cm or expanding. Laceration:>3cm parenchymal depth.
IV	Laceration: parenchymal disruption involving 25-75% of hepatic lobe or 1-3 couinaud'ssegments in ONE lobe.
V	Laceration: parenchymal disruption involving >75% of hepatic or>3 couinaud's segments within one lobe. Vascular: juxta-hepatic venous injuries ,retro-hepatic venacava/ central major hepatic veins.
VI	Vascular: hepatic- avulsion.

AAST(AMERICAN ASSOCIATION FOR THE SURGERY FOR TRAUMA) **GRADING OF SPLEENIC INJURY :**

Table 3

GRADESOF INJURY	***DESCRIPTION***
I	Hematoma: Sub-capsular, non-expanding<10% of surface area. Laceration: capsular -tear, non bleeding, <1cm Parenchymal depth.
II	Hematoma: Sub-capsular, nonexpanding, 10-50% of surface area, Intra-parencymal, nonexpanding, <2cm in diameter. Laceration: capsular tear with active- bleeding.
III	Hematoma: Subcapsular, >50% surface area, or, Expanding, ruptured Sub-capsular hematoma, active Bleeding. Intra-parenchymal hematoma ➢ 2cm or Expanding. Laceration:>3cm parenchymal depth , involving trabecular vessels.
IV	Hematoma: ruptured intra-parenchymal hematoma with activebleeding. Laceration : involving segmental ,hilar vessels producing major De-vascularization (>25% of spleen)
V	Completely shat-tered spleen. Hilarvessel injury that devascularises the spleen.

AAST(AMERICAN ASSOCIATION FOR THE SURGERY OF TRAUMA) **GRADING OF RENAL**

Table 4

GRADE OF INJURY	***DESCRIPTION***
I	Contusion Microscopic or gross hematuria, urologic studies negative Hematoma Sub-capsular, non-expanding without parenchymal laceration
II	Hematoma : Nonexpanding perirenal hematoma confined to renal retroperitoneum Laceration :$<$1 cm parenchymal depth of renal cortex without urinary leak
III	Laceration :$>$1 cm parenchymal depth of renal cortex without collecting system rupture or urinary extravasation
IV	Laceration :Parenchymal laceration extending outto renal cortex, medulla, and collecting system Vascular :Main renal artery or vein damage with contained haemorrhage
V	Laceration : Completely shattered kidney Vascular :Avulsion of renal hilum, De-vascularizing the kidney

GRADING OF PANCREATIC INJURY :

Table 5

Type	Definition
1	Contusion and laceration with-out duct injury
2	Distal -transection or parenchymal injury along with duct injury
3	Proximal tran-section or parenchymal injury with probablyinjured duct .
4	Combined pancreas and duodenuminjury ,Ampulla and bloodsupplyintact .
5	Massive injury, ampulla destroyed, devascularisation

DIAGNOSTIC TAPPING(FOUR QUADRANT TAP)

This is a supplemental rapid test but some- times this test may be omitted by surgeons and proceed immediately with peritoneal lavage. Under local anesthesia, and by an aseptic technique, all four- quadrants of the patient abdomen are tapped using a 19 G needle.

If aspiration is negative the test is repeated after taking the needle out and after rolling the patient towards the side of the suspected injury. If aspiration is still negative, the test can be repeated in an hour or two, or Diagnostic Peritoneal Lavage (DPL) can be tried as described below. Blood in a hemoperitoneum is usually defibrinated and does not clot. But this may not so in some cases. Hence a negative result does not rule out an abdominal injury.

Sometimes urine (from a ruptured bladder), cloudy or bile stained fluid or pus (in primary peritonitis) may be aspirated. The aspirate thus obtained can also be examined after Gram staining (for bacteria, leucocytes, or food).

DIAGNOSTIC PERITONEAL LAVAGE (DPL)

In hypotensive or unresponsive blunt trauma patients, without any obvious indication for abdominal exploration, DPL can be used to identify intra-abdominal injuries. A peritoneal dialysis catheter or an 8 – 10 Fr polyvinyl urethral catheter is used. The bladder is emptied by an indwelling catheter and 1% lignocaine and adrenaline are used to infiltrate the midline for approximately 3 cm below the umbilicus. A small midline sub umbilical incision is made through skin and subcutaneous tissue over a length of about 3 cm. Hemostasis is secured and the lineaalba incised to expose the extra peritoneal fat. The peritoneum is then grasped with two forceps and a purse string suture inserted circumferentially around these. A 2-3 mm incision is made in the peritoneum and the peritoneal dialysis catheter inserted down into the pelvis, drawing the purse string suture tight as this is done. If blood enters the catheter immediately no more investigation is necessary and except to proceed to exploratory laparotomy or other diagnostic modality depending on the physiological state of the patient. Otherwise, 1 liter of isotonic saline or Hartmann's solution is run in through the catheter from a routine infusion set over a period of a few minutes. The empty bottle or pack is placed on the floor and the lavage fluid allowed to reflux by gravity (Figure 2).

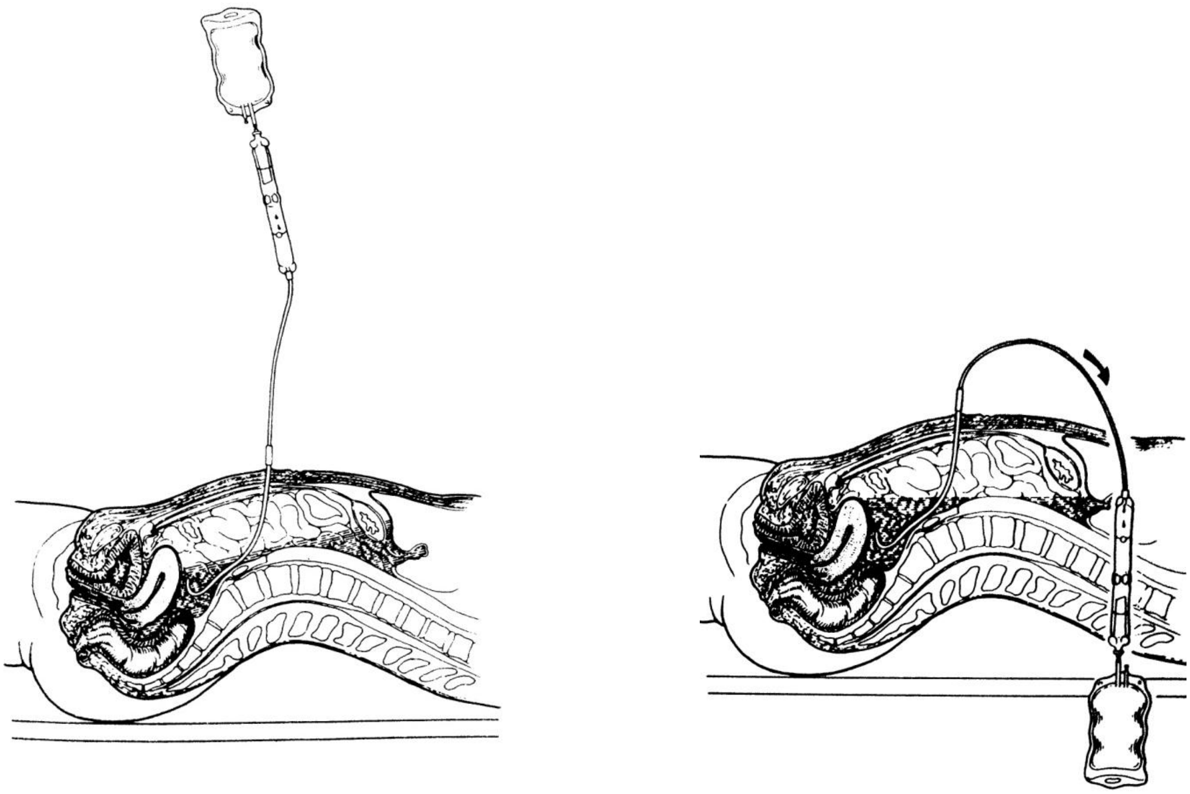


Fig 14 :Diagnostic Peritoneal Lavage

Lavage strongly positive:

If the refluxed fluid is red and opaque or if print cannot be read through the tubing of the bag or flask then an exploratory laparotomy is mandatory.

Lavage weakly positive:

If the refluxed fluid is pink or merely a tinge of color and print can be read through it then clinical observation, and, if available, more complex investigations should be carried out. Retroperitoneal hematoma is the most common cause of ’weak positive’.

Lavage negative:

If the refluxed fluid is crystal clear then the patient is observed clinically for 24 hrs.

Other indications of a positive lavage are bile or bowel content and lavage fluid appearing in the chest drain or urinary catheter. In doubtful cases the catheter should be left in situ and the procedure can be repeated 4-6 hrs later. Standard criteria (Table 1) for positive DPL result in blunt injury include aspiration of atleast 10 mL of gross blood, a bloody lavage tapping, a RBC count greater than 100,000/mm^3, a WBC greater than 500/mm^3 (this is equivalent to 20ml of free blood in the abdominal cavity), Amylase level excess of 175 IU/dL, or detection of bile salts pigments, bacteria, or food particles. Drainage of lavage fluid via a chest drain indicates penetration of the diaphragm. Although DPL has largely been replaced by focused abdominal sonar for trauma (FAST), it remains the standard in many institutions where FAST is not available or is unreliable. DPL is especially useful in the hypotensive, unstable patient with multiple injuries as a means of excluding intra-abdominal bleeding.

Table 6: Outcomes of peritoneal lavage

OUTCOMES OF PERITONEAL LAVAGE	
Laparotomy required	1. RBC > 100 000/mm^3 2. WBC > 500/mm^3
Indeterminate	1. RBC 50 000 – 100 000/mm^3 2. WBC 100 – 500/mm^3
Non-operative management depending on circumstances	1. RBC < 50 000/mm^3 2. WBC < 100/mm^3

Indications

- Equivocal physical examination
- Unexplained shock or hypotension
- Alteredmentum (closed skull injury, drugs, etc.)
- General anesthesia for other operative procedures
- Spinal Cord injury

Contra-indications

- Clear- indication for exploratory surgical management

  Relative Contra-indications

  - Previous exploratory surgical laparotomy

- Pregnant ladies
- Obese induviduals

Significant trauma may also be lost by DPL. Diaphragmatic rents retroperitoneal hemmorrhages, and renal,pancreatic,duodenal, minor intestinal and extra peritoneal bladder injuries are more frequently under diagnosed by DPL alone. DPL findings can be misleading in a pelvic fracture. Falsely positive reportss are expected with bleeding from the retroperitoneum into the peritoneal cavity. Anterior abdominal and flank wounds can be accurately evaluated by DPL. Falsely positive results are common after DPL because of bleed of the abdominal wall, thus increasing the number of negative laparotomies. Another potential drawback of DPL is its low accurate results in the diagnosis of hollow viscus injuries.

Complications are not common and mostly related to inadvertant injuries caused during insertion of a catheter into the peritoneal cavity. A semi open or open method should be the preferred method to avoid or decrease the rate of such side effects.

DPL has a 97–98% sensitivity rate for blood and a 1% complication rate. In total, 10–15% of laparotomies performed on the basis of a ‘positive’ DPL do not require active intervention. In principle, therefore, a negative DPL is often more helpful than a positive one, because the presence of blood in the abdomen does not necessarily require surgery. DPL is most sensitive to the presence of intraperitonealhemorrhage; but, its specificity is low, and since positive DPL findings prompt laparotomy, a significant number of negative laparotomies occur.

LAPAROTOMY :

PRINCIPLES OF ABDOMINAL SURGERY FOR TRAUMA

Decision making

The extent of intra peritoneal damage can be totally assed by the formal laparotomy procedure described above. This assists the surgeon to assess priorities and decide upon the course of surgery. For this to occur it is important that the operator communicates findings and intentions to colleagues, so that both scrub nurse and anesthetist can then participate. One will mobilize the necessary instruments and suture materials, while the other can begin to plan the duration of anesthesia and likely resuscitative needs.

Principles of operation:

Incision: the upper abdomen is best explored in patients with blunt trauma through a midline upper abdominal incision. If on exploration, injury to the hepatic veins is suspected, exploration of the region of the hepatic veins should not be attempted through the abdominal incision. When improved exposure of the superior and posterior surface of the liver is required, a combined right thoraco-abdominal incision is usually necessary. If the peritoneal cavity is contaminated with fecal contents, extending the abdominal incision into the chest is justifiable only under life threatening conditions.

Hepatic injury : The presence of blood and clots in the right upper quadrant may signal the presence of a hepatic injury. When these clots are removed, inspection and palpation may identify the fracture or disruption of hepatic substance. In the absence of other abdominal injuries, attention is directed to the hepatic injury.

Splenic injury :

The patient is positioned supine on the operating table and may be rotated 15 degrees toward the operating surgeon (standing on right side) so that there is greater exposure of the left upper quadrant. A midline incision, with adequate extension to the xiphoid, is preferably used to facilitate exposure and treat associated injuries.

Complete mobilization of spleen is the key to adequate assessment of injury and safe repair. With adequate retraction of the left upper quadrant, the splenic exploration begins by direct visualization and careful palpation. Any blood should be evacuated from the area in order to optimize visual and palpatoryexamination.If splenic injury is apparent, spleen should be mobilized form its surrounding attachments, the lienorenal and phrenicolienal ligaments are avascular and can be sharply incised away from the lateral margin of the spleen. The vessels in thelienocolic ligament may need to be ligated and divided. Complete removal of clot is necessary to assess the extent of splenic injury. Clot can be removed by gentle irrigation or grasping with forceps. Persistent massive bleeding from spleen usually can be controlled by manual compression of the splenic organ. If this is not successful temporary control of the splenic artery at the superior pancreatic margin by grasping the splenic pedicle with thumb and fore finger is helpful when there is persistent active bleeding.

Pancreatic injury :

Laparotomy is the single most reliable means of making the diagnosis of pancreatic injuries.

A management plan based on these principles requires that the surgeon ascertain the following:

1. The presence or absence of associated organ injuries, particularly the duodenum.
2. The degree of pancreatic parenchymal disruption.
3. The integrity of the main pancreatic duct and ampulla.

Renal injury : As applied to early or interventional surgery.

1. Approach: anterior trans peritoneal, either vertical (paramedian) or transverse incision.
2. Initial dissection of renal arteries: bulldog clamp applied to renal artery and then vein. Only then the gerota's fascia is opened by making a paracolic incision.

3. Actual operative procedure will depend on pathological lesion found. Basically the objective is renal salvage.

Aortic clamping

There are two occasions where it may be necessary to clamp the aorta to save the patient from death by rapid exsanguination; first, when the abdomen has been opened and catastrophic bleeding cannot be assessed or controlled by conventional measures; and secondly, when there is the likely hood that if the abdomen is opened, bleeding, until then at least partially controlled by tamponade, becomes much more severe and rapidly produces profound hypotension. In the former the aorta may be approached and controlled below the diaphragm. If the later is anticipated a decision must be made as to whether to go straight to laparotomy or to perform a prelaparotomy thoracotomy and clamp the lower thoracic aorta; by doing this, adequate supra diaphragmatic aortic pressure can be maintained while the abdomen is initially explored, but unless the thoracotomy is performed quickly, control of bleeding is further delayed. The infra diaphragmatic approach is associated with less delay but there is a greater risk of sudden precipitous drop in blood pressure when the abdomen is opened. The decision between the two techniques is difficult to make and much guided by individual circumstances. The only certain thing is that with patient in extremes, speed in both decision making and operation is of the essence.

Procedure at laparotomy

Massive life threatening bleeding nearly always has an obvious source and should be arrested at once by finger pressure or, in the case of the liver, by a pack. Blood is then scooped and sucked out from all four quadrants as completely as possible; this is an important step because if clearance is achieved at once then the re accumulation of blood indicates an uncontrolled lesion. The best technique for evacuating blood is to insert the hand palm upwards and suck in the concavity so produced. From this point on there are only two contraindications to preliminary complete formal laparotomy

Thoracolaparotomy

Mention has already been made of extending a laparotomy incision into the chest by cutting across the rib margin either to right or left. In such circumstances, it is usually easiest to proceed along an intercostal space. As the costal margin is crossed, the fibers of transversusinterdigitate with those of the diaphragm and the incision is extended along this line in the substance of the later structure, catching and under running branches of the phrenic vessels. The costal margin can now be held apart with a self retaining retractor so permitting a good view of the abdominal viscera deep under the rib cage.

Formal thoracotomy or thoracoabdominal laparotomy may be primarily indicated on the grounds already described. The incision is the classic one for the radical esophagogastrectomy on the left, and the opposite on the right. With the patient in a semi lateral position with the upper leg extended and the under leg flexed, the incision runs from the angle of the scapula obliquely forwards in the line of the 9th rib to just above the umbilicus. Entry into the chest exposes the dome of the diaphragm; in this instance the diaphragmatic incision runs backwards from the costal margin 2 cm medial to the rib below, so detaching the hemi diaphragm peripherally, lessening bleeding and preserving function. The posterior end of the cut in the diaphragm may curve upwards and medially toward the hiatus but it is not usually necessary to take the incision as far as the esophagus or caval opening in the management of trauma except that to the great vessels. As the diaphragm is incised a self retaining retractor, previously inserted between the 8 and 10^{th} ribs, is progressively opened, so keeping the structures on the stretch. All layers of the abdominal wall are now divided in the line of the incision, tying the superior epigastric artery in the rectus sheath. Even more room can be obtained by cutting into, or across, the contra lateral rectus sheath and muscle.

At the close of the procedure, a large multi perforated tube is inserted the full length of the chest, through a stab incision in the 10^{th} inter space below and behind the wound, and connected to an underwater seal. The diaphragm is carefully reconstituted with a continuous suture of mono filament absorbable or non absorbable material and the chest and abdominal wall are closed in one layer deep to the skin with interrupted or continuous mono filament. Convalescence from this apparently formidable hemi section is usually gratifyingly smooth, although assisted ventilation may be needed for a short period.

Fig 15: Intra op photo showing Liver laceration

Fig 16: Splenectomy specimen showing multiple laceration

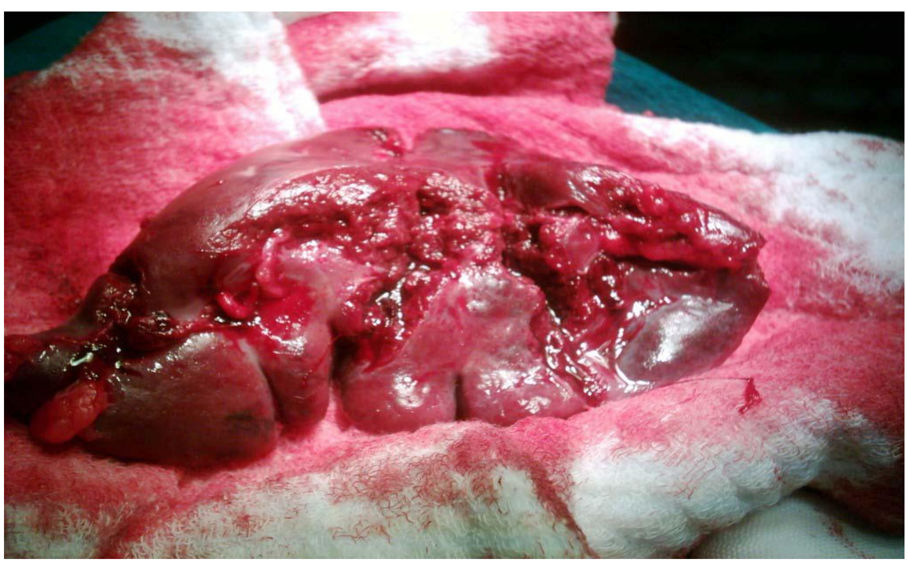


Fig 17: Intra op photo showing pancreatic injury

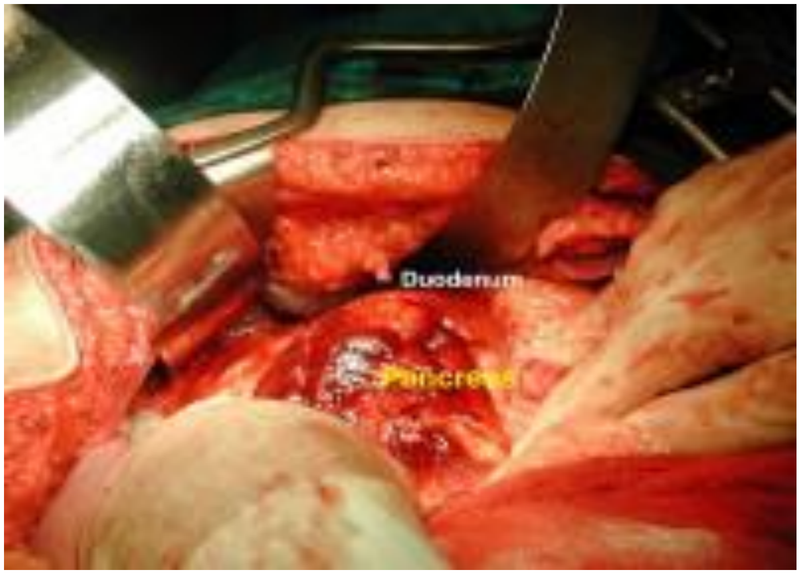


Fig 18 showing intestine and mesenteric injury

Formal laparotomy

Formal laparotomy is carried out by eviscerating all small bowel upwards and to the right over the right edge of a vertical laparotomy. Removal of the bowel from the abdominal cavity now permits the pelvic contents to be seen and floor of the pelvis to be cleanly sucked out. Inspection continues around the descending, transverse and ascending colon and leading on to the whole small bowel. This completes the infra colic compartment. Next, the colon is displaced downwards and the spleen and the left diaphragmatic cupola are examined. The stomach is then both exposed and palpated, and the left and right lobes of the liver (with gall bladder) and finally the anterior face of the duodenum and pancreas are examined. Finally if injury from behind has occurred or a missile tract from in front suggests the need:

- The lesser sac below the stomach is opened and the pancreas is examined
- The right colon and duodenum are mobilized by a long incision in the posterior parietal peritoneum of the right paracolic gutter stretching from the bottom of the right iliac fossa to the under surface of the liver. This also serves to expose the right kidney, although significant injury to either of this organ is usually manifest soon after the abdomen has been opened because of the presence of retro peritoneal hematoma.

A complete and rigorous laparotomy of this kind is particularly but not exclusively necessary in high-velocity penetrating injuries, where multiple or disintegrating projectiles may wreak damage over a wide area. Only by the minutest inspection of every centimeter of gut will the operator avoid occasionally missing small perforation that has occurred inn the mesenteric border or, particularly in large bowel, that is veiled by omentum. Although it can be objected that a laparotomy of this kind takes time, adherence to a uniform method and avoidance of repetitive maneuvers permit it to be pushed through with rapidity. Such an approach can save both life and hours of subsequent surgery necessitated by the complications that may ensue from an undiscovered lesion.

MATERIALS AND METHODS

METHODOLOGY

Source of data:

Patients admitted in trauma ward of rajiv Gandhi govt general hospital attached to the Madras Medical College and Research Institute,

Methods of collection of data:

After admission data for my study was collected by:

1. Direct interview with the patient or patient relatives accompanying the patient andobtaining a detailed history.
2. Thorough clinical examination.
3. Clinical findings and relevant diagnostic investigations performed over the patient.

All injured were brought to a emergency resuscitationarea where primary-survey, resuscitation, and a secondary -surveyin a standard, method is conducted. The FAST investigationwas performed during primary-survey, aftersecuring airway and establishing the adequate oxygenation/ventilation needed were met.All patient scanned by a FAST investigation.

The FAST investigation were performed using 4 windows: subxiphoid, right-upper quadrant(morrison'sspace), left- upper quadrant, and supra-pubic. Thecritical windows for intra-abdominal bleeding were the hepato-renalspace (Morrison's space), the spleno-renal space, andthe pelvic pouch of Douglas.with a USG machinekept in the trauma ward resuscitation area, wasused for these examinations.

The FAST investigation was classified as positive (clearlyshowing fluid on at least one window), or negative (good scan in at least threeviews, no fluid). No quanti-tative score systemwas used for the quantity of fluid seen. The primary aimof the FAST investigation was to detect intra-peritoneal blood. Second, the aim of FAST was to detect peri-cardialfluid and blood. There was no attempt to evaluate visceralorgan injury.

The FAST exam wasperformed in real time. There was no "second view" northe radiologists give a follow-up report.CECT scans of abdomen wereperformed in all patients,.Astion spiral CT machine was usedPatientswere classified into FAST +veandFAST-ve

All the patients were operated and the findings of FAST and CECT correlated With peroperative findings.

Data were tabulated and sensitivity of investigations analysed

OBSERVATIONS

AGE & SEX DISTRIBUTION:

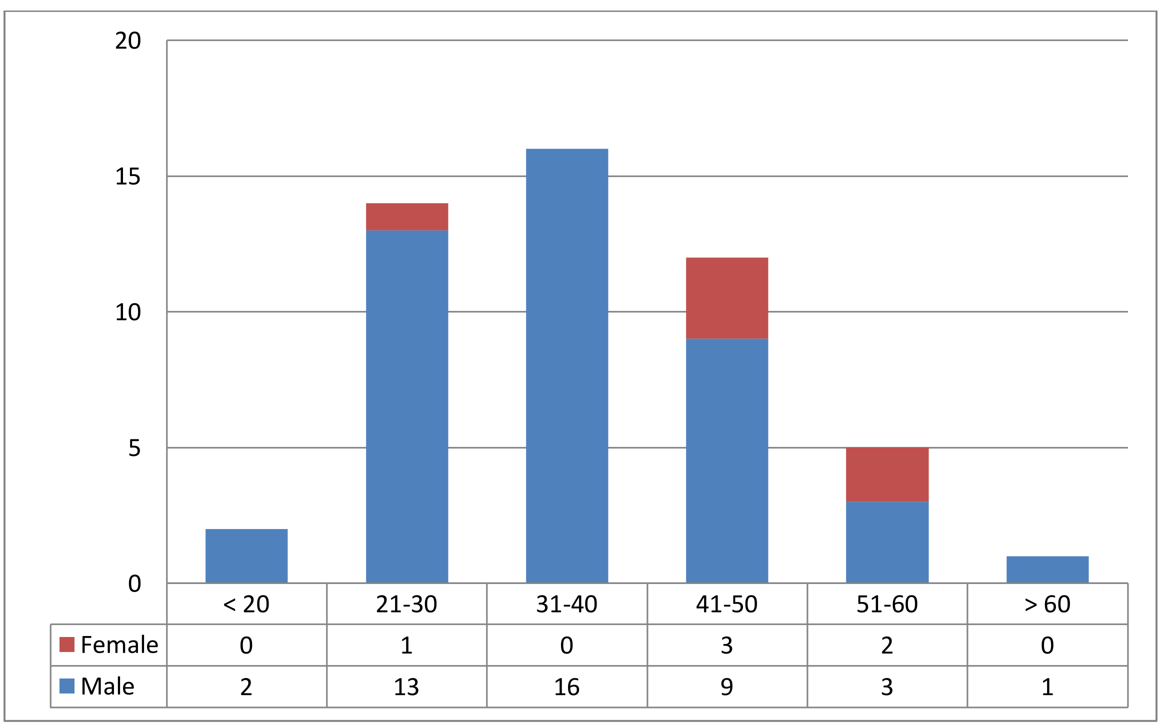
A total of 50 cases of blunt injury abdomen presenting in our trauma care setup were included in our study . Of these cases 44 cases (88%) were males and 06 cases (12%) were females. The range of age of the patients studied was from 16 years to 72 years and the mean age of the study group was 37.22 years.

The greatest distribution of cases was found in the 31-40 year age group with 16 cases (32%), followed by 21-30 years age group with 14 cases (28%) and 41-50 years age group with 12 cases (24%). Only 2 cases(4%) were documented in the < 20 years age group and one case (2%) in the > 60 years age group.

Cumulatively, the age groups of 21-50 years represented the bulk of the study population with 42 cases (84%).

Table 7 showing Age & Sex Distribution

AGE & SEX DISTRIBUTION				
AGE RANGE *(in yrs)*	MALE	FEMALE	TOTAL	%
<20	02	00	02	04
21-30	13	01	14	28
31-40	16	00	16	32
41-50	09	03	12	24
51-60	03	02	05	10
>60	01	00	01	02
TOTAL	44	06	50	



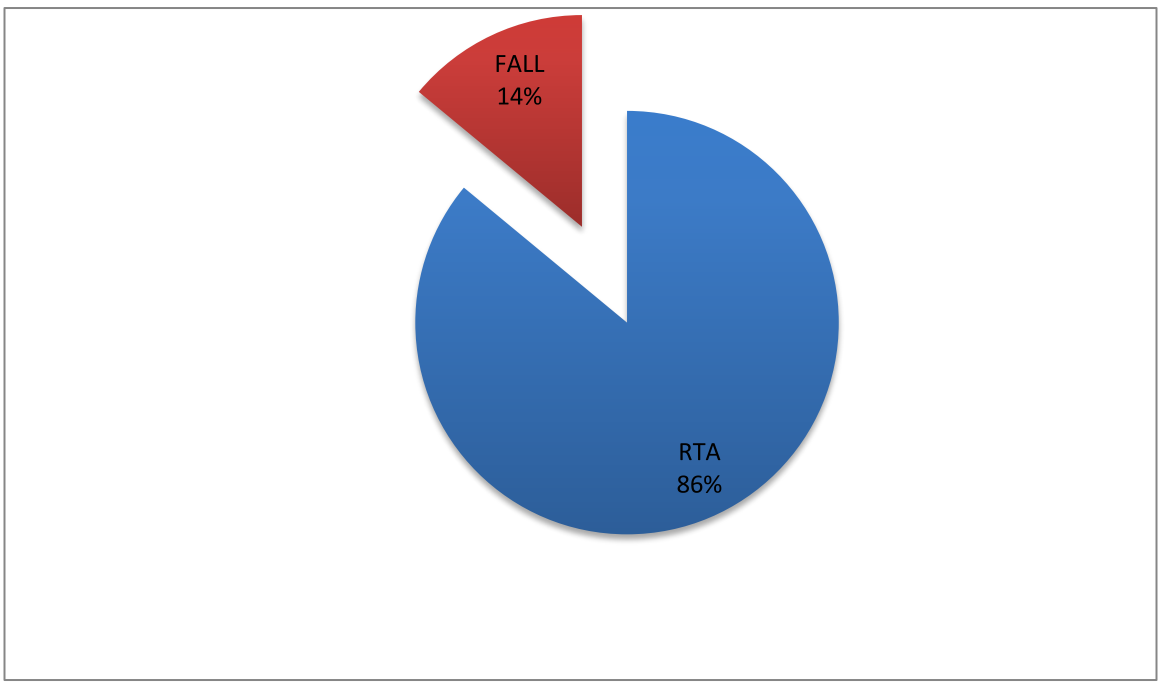
Age and sex distribution chart

MODE OF INJURY:

In our study, Road traffic accidents were the predominant cause of blunt injury with 43 cases (86%) being attributed to Road traffic accidents. Rest of the cases were due to fall from height .

Table 8 showing Mode of Injury

MODE OF INJURY		
MODE OF INJURY	CASES	%
RTA	43	86
FALL	07	14
TOTAL	50	

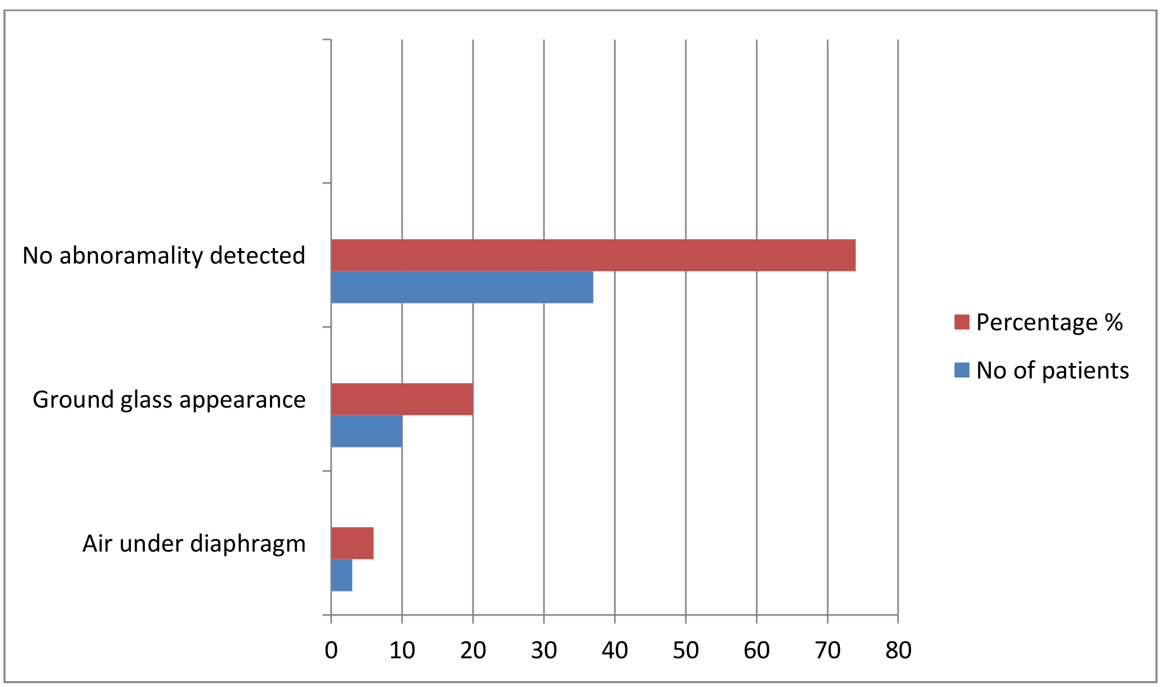


Mode of injury chart

Table 9 showing findings of xray chest /abdomen erect:

Xray	No of patients	Percentage %
Air under diaphragm	3	6
Ground glass appearance	10	20
No abnoramality detected	37	74

Chart showing findings of ofxray chest /abdomen erect:



FAST (FOCCUSED ABDOMINAL SONOGRAPHY IN TRAUMA)

FAST was done in all 50cases .

POSITIVE IN 49 PATIENT NEGATIVE IN 1 PATIENT

Table 10 showing results of FAST

Result	No of patients	Percentage
Positive	49	98 %
Negative	1	2 %

Chart showing result of FAST

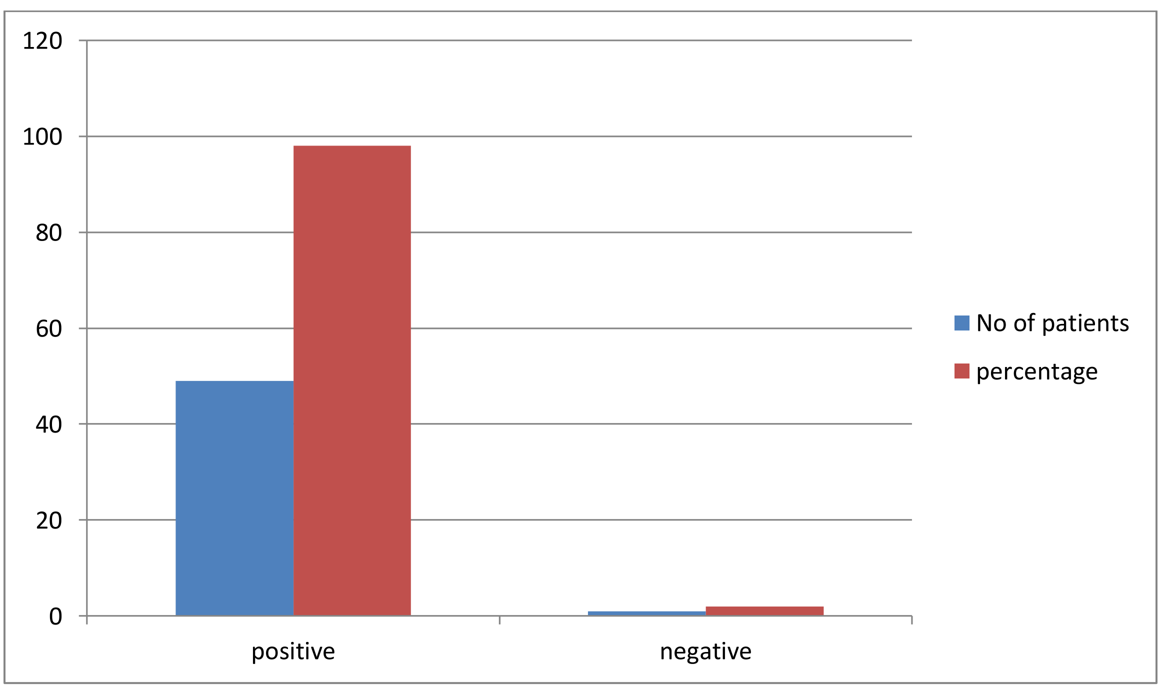
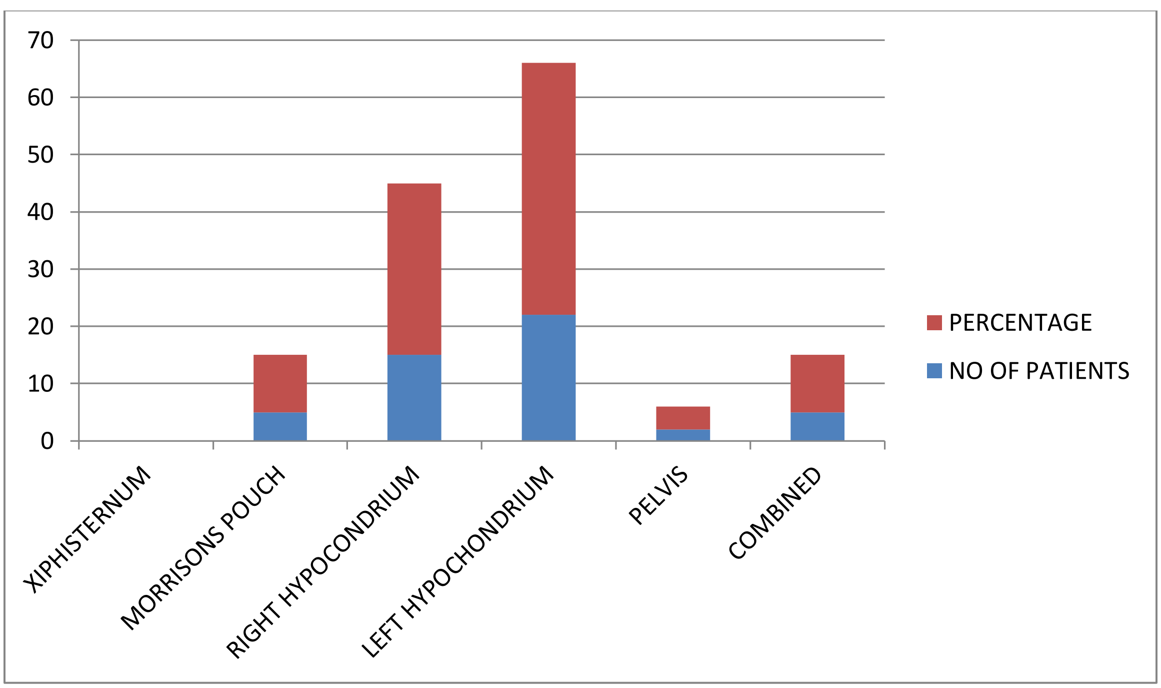


Table11 showing FAST positive patient

QUADRANTS	No of patients	Percentage
XIPHISTERNUM	0	0 %
MORRISON POUCH.	5	10 %
RIGHT HYPOCHONDRIUM	15	30%
LEFT HYPOCHONDRIUM	22	44 %
PELVIS	2	4 %
COMBINED	5	10 %

Chart showing FAST positive patients

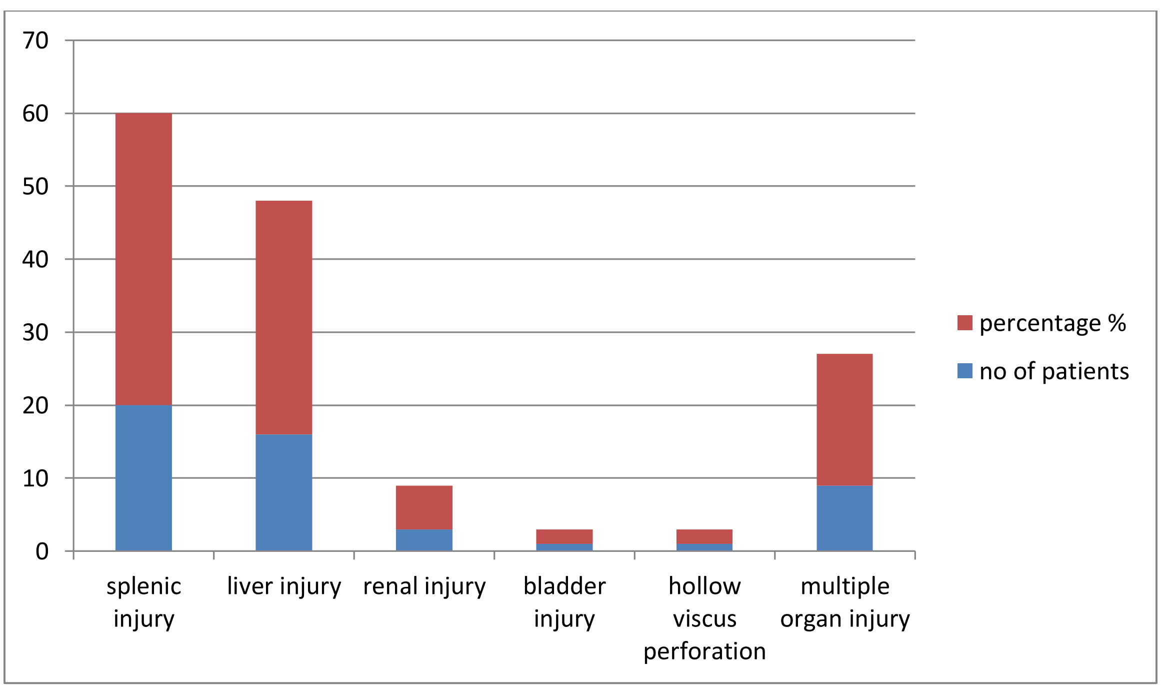


RESULTS OF CECT

Table12 showing Results of CECT

CECT findigs	No of patients	Percentage %
Splenic injury	20	40
Liver injury	16	32
Renal injury	3	6
Bladder injury	1	2
Holloviscus perforation	1	2
Multiple organ injury	9	18

Chart showing Results of CECT



COMPARISON OF FAST VS CECT

Table 13

Investigation	No of pt positive	No of pt negative findings	sensitivity
FAST	49	1	98 % %
CECT	50	0	100 %

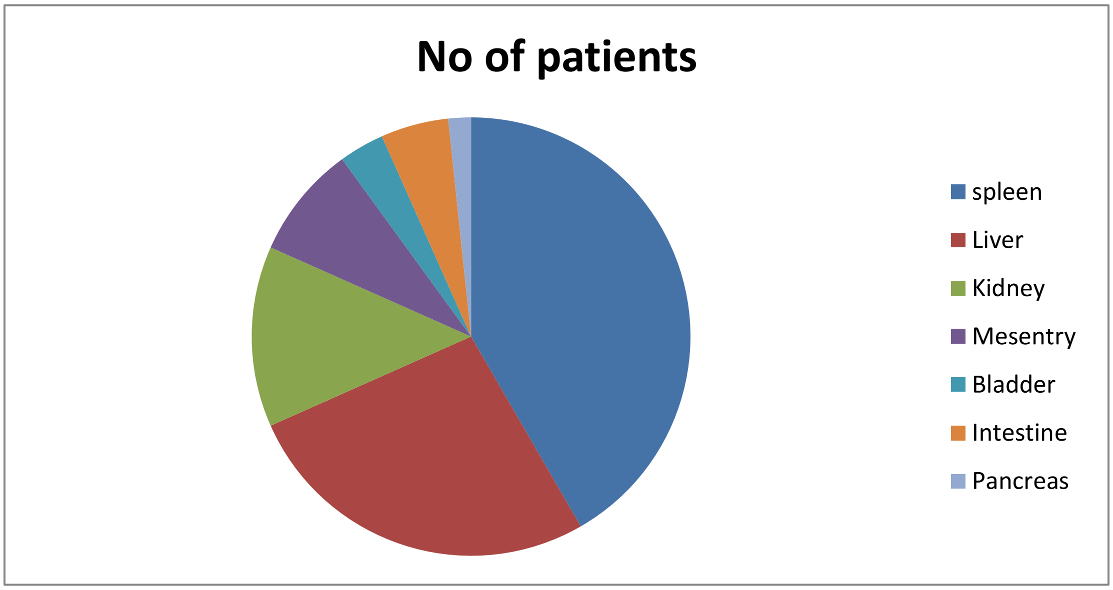
ALL 50 PATIENTS HAD PEROPERATIVE FINDINGS CORRELATING WITH CECT

Table 14 showing organs involved in blunt injury abdomen :

Organ involved	No of patients	Percentage %
spleen	25	50
Liver	16	32
Kidney	8	16
Mesentry	5	10
Bladder	2	4
Intestine	3	6
Pancreas	1	2

Chart showing organs involved in blunt injury abdomen

:



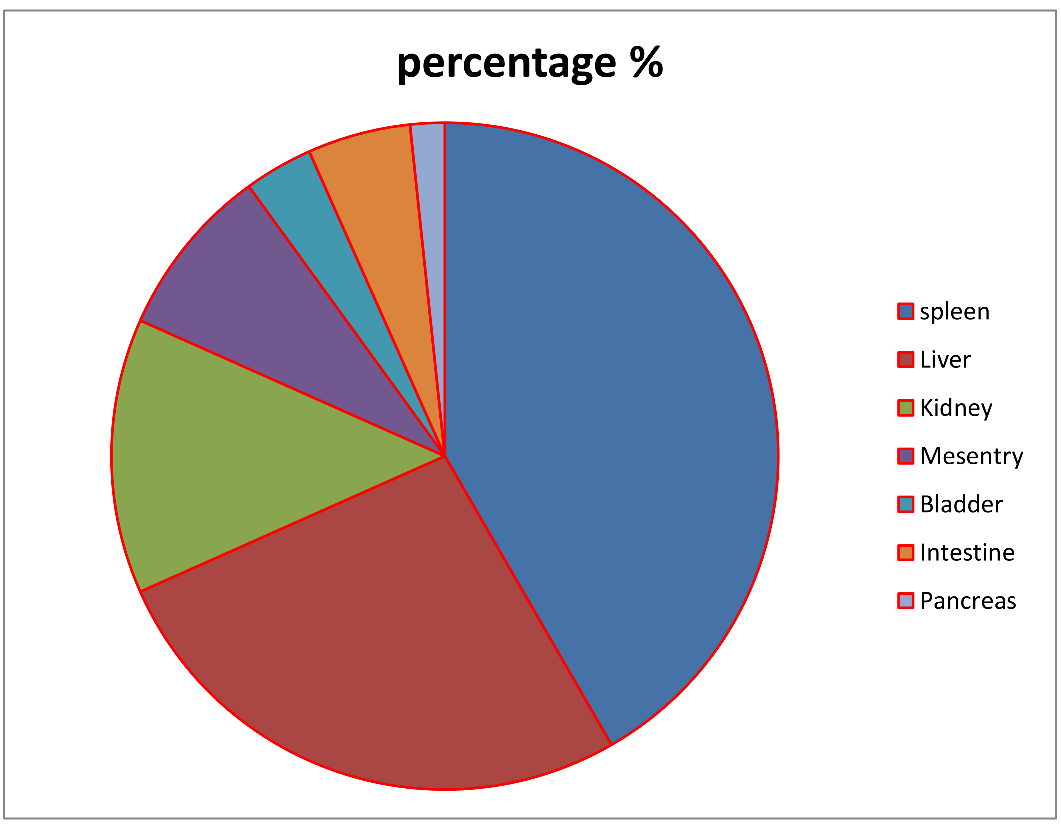
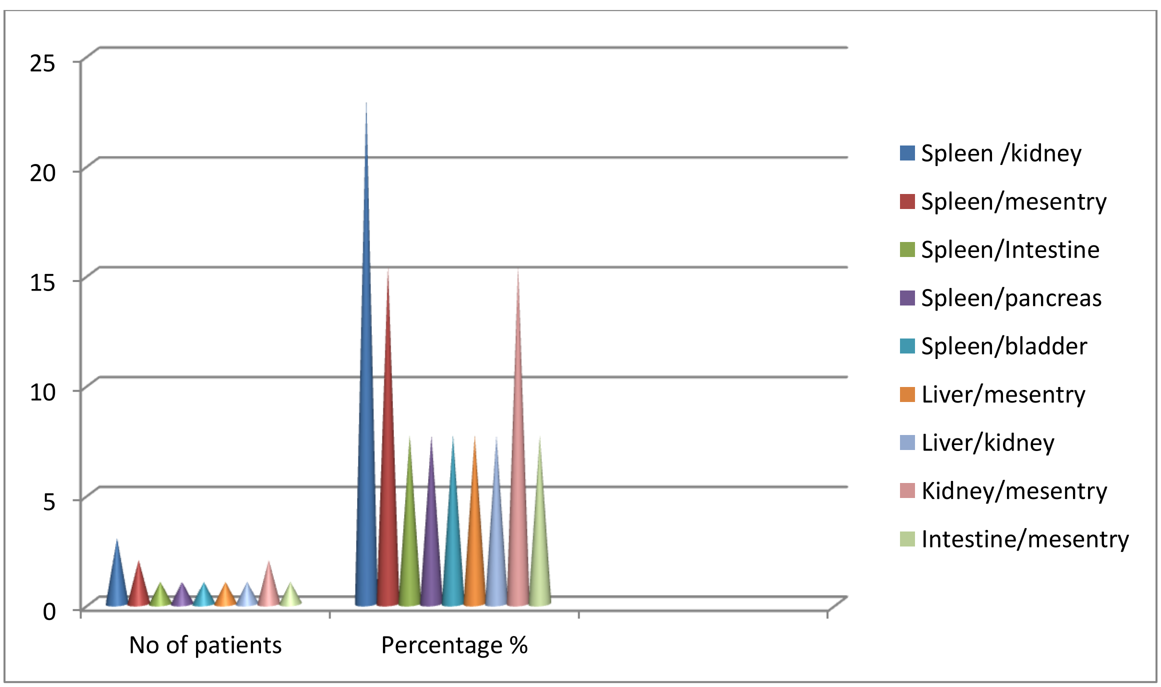


Table 15 showing combinations of organs involved :

Organs	Spleen /kidney	Spleen/ mesentry	Spleen/ Intestine	Spleen/ pancreas	Spleen/ bladder	Liver/ mesentry	Liver/ kidney	Kidney/ Mesentry	Intestine/ Mesentry
No of patients	3	2	1	1	1	1	1	2	1
Percentage %	23.07	15.38	7.69	7.69	7.69	7.69	7.69	15.38	7.69

Chart showing combinations of organs involved :



DISCUSSIONS

DISCUSSION

Mode of injury:

Cause	Our study	Davis et al	Khanna et al
Road Traffic accident	86 %	70%	57%
Fall from height	14 %	6%	15%

Table 16: Mode of injury comparison

From above table it clearly states that RTA is the most common mode of injury because ofincreased number of vehicles recently. The young people also give priority to speed ratherthan safety.

Plain X ray erect abdomen:

Plain erect X ray of abdomen was done in all cases. Gas under diaphragm was found in 3 cases. In Davis et al study abdominal X ray was abnormal in 21% cases. In our study it is 6 % abnormal.

FAST (focused abdominal sonography in trauma):

Organinjured	Our study	Cusheri	Davis et al	Cox et al	Khanna et al
Spleen		25%	25%	46%	26%
Liver		15%	16%	33%	37%
Kidney					
Pancreas					
Mesentery		5%	4%	10%	47%
Bladder		6%	4%		

Table 17: Comparison of results of USG (FAST)

USG abdomen (Focussed Abdominal Sonography for Trauma) was done in all cases out of which 47 cases had solid organ injury. Therefore USG abdomen is more reliable in detecting solid organ injury and free fluid in the abdomen.

From above table, spleen is the most common organ injured in BIA as compared to international series, accounting to 40%, followed by liver in 37.5% cases and kidney in 12.5% cases.FAST is important in early decision.

FocussedabdominalSonography in Trauma (FAST) examination of peri-cardial, peri-hepatic, peri-splenic and pelvic areas help in early detection of clinically important abdominal injury. FAST exam can be performed number of times and is an excellent tool in addition toto physical examination.

CT scan abdomen:

CECT was done in allcases.It was positive in all cases .Contrast enhanced computed tomography (CECT) can provide trusted information on hemoperitoneum, grade of solid organ injuries, retro-peritoneal organ injuries, most case of hollow viscusdamage and ongoing bleed by means of radiographic blushing.

ORGAN WISE INJURIES :

LIVER :

Incidence: The secondly more commonly injured- organ is liver in all patients with blunt -abdominal injury. Incidence being 35-45% of patients with abdominal trauma.

Mechanism of injury: Blunt injury results from direct -blows, compression between the lower rib on the rightside and the spine or shearing at fixed point due to deceleration.

Clinical manifestations: major hepatic injuries are usually easy to detect because of thelocation of trauma, profound hypotension temporarily responsive to the infusion of blood andfluids and marked abdomen distension. Small hepatic tears from blunt trauma or lacerations are more difficult to detect as hemorrhage from such injuries may be limited and may have stopped when the patient arrives in the emergency center.

A variety of diagnostic agents have been utilized in recent years to evaluate possible hepatic injuries for these reasons.

Plain x ray chest and abdomen: seldom of assistance in the diagnosis of hepatic injury.

Ultrasound:(FAST) can reveal a break in the liver contour and disruption of normal hepatic architecture. Fluid that is presumed to be blood may be visualized around the liver

Can be used as a screening procedure.

CT scan: CT scan can specifically identify an injury such as disruption of hepaticarchitecture and intrahepatic bleeding, subcapsular or intra hepatic hematoma andperihepatic blood can be seen. An infusion CT scan might reveal decreased density in anarea of liver with compromised blood perfusion. The correlation of extent of injury by CTand that found at the time of operation may not be precise, with instances of both over andunder estimation. Despite this limitation, CT has clearly become the gold standard amongthe imaging modalities available for evaluation of hepatic trauma. In the era of selectivenon-operative therapy, knowledge of the nature of the hepatic injury is essential in the

selection of the therapy.

SPLEEN :

It is the single commonest visceral organ to rupture following blunt trauma. Factorscontributing to its increased susceptibility to injury in trauma are:

1. The soft consistency of the organ.

2. Its intimate contact with ninth to twelfth ribs and

3. Its tendency to enlarge becoming pulpier with variety of disease.

Pathology:

It is usually an avulsion from the pedicles, multiple fissure fractures, an enlarged spleen splitting on its outer aspect to produce either a tear or subcapsular hematoma. Less usually is a small tear in the anterior aspect of hilum, which may produce severe bleeding but will escape from detection.

Clinical presentation:

The 3 possible scenarios, a patient with splenic injury can present are:

1. Patient may succumb rapidly to trauma, without recovering from shock.

2. Initial shock followed by recovery with signs of rupture.

3. Delayed rupture after few days.

1. Rapid death: the spleen will be avulsed or severely mangled by blunt abdominal trauma.

The patient dies before resuscitation or a laparotomy could be performed.

2. Shock: this is due to rupture. This is the largest group. Trauma to the abdomen or lower thorax is followed either by an absence of symptom for some hours or vague distress.

Then suddenly with a matter of minutes patient symptoms are exaggerated. There is abdominal rigidity and circulation becomes apparent. The patient shows variable signs of hypovolemia and there is evidence that points to serious intra abdominal pathology.

The patient is pale. Abdomen may be slightly distended. Abdominal rigidity is variable ranging from generalized rigidity to that localized to left upper quadrant and extending towards the flank. Tenderness is likely to be variable. But commonly it is presented in the lefthypochondrium and frequently pain is accentuated in deep breathing. In early cases, pulse may not rise above 90 and blood pressure is often unaltered for several hours.

Referred pain to the left shoulder is a valuable symptom. In this group latent period is characteristic because a subcapsular hematoma forms and ruptures quickly.

3. Delayed rupture: when the trauma and acute events, which lead to surgery, are separated by dayssome times months. The diagnosis can be made by four general methods.

History of injury in the recent past with general signs of blood loss associated with local signs like bruising, tenderness, rigidity, fractured ribs, Balance’s sign positive, Kehr’s sign positive.

Presence of palpable tender spleen.

Radiography: plain x ray may show:

- Fractured lower ribs on left side.
- Rise of left dome indiaphragm or pleural effusion.
- Diaphragmatic rupture.
- Increased density in the left hypochondrium.
- Dis-placement and indentation of greater curvature of stomach.
- Transverse colon displaced downwards.
- Radioisotope scanning is useful in diagnosis in about 90% of cases.

Other signs of splenic injury are:

1. *Balance's sign* : fixed dullness in the left flanks and right flank. Changes of dullness on change of position.

2. *Seagesser'ssign* : pain produced in the neck by pressure over the phrenic nerve over the left supraclavicular region.

3. *Hardisign* : sternal saggital compression produces sharp pain below the left costal margin in splenic rupture.

4. *Snow ball sign* : bulge in the pouch of Douglas due to hemoperitoneum. induviduals withsymptoms related to spleen may be investigated with ultrasound, scintigraphy, angiography,

CT or DPL.

Ultrasound (FAST) has been used successfully in the diagnosis of splenic injury and remains useful adjuncts in the absence of CT. Because it is rapid and non invasive, it is recommended to follow the healing of a known hematoma. Ultrasound has its own technical drawbacks, including image limitation by dressings, tubes, wounds, gastrointestinal ileus, and problems with positioning a severely injured patient.

Pancreas:

The incidence of pancreatic injury in severe abdominal trauma patients is about 3-12% with blunt trauma contributing about 1/3 of these patients. The spectrum in pancreatic injuries iswide, ranging from simple contusion to fracture/ laceration to complete disruption.

The proximity of pancreas to nearby vital organs and the high- energy mechanisms typically involved make isolated pancreatic injuries uncommon. Wounds of the head of the pancreas are commonly associated with blunt injuries to the liver, duodenum and major vascular structures.

Injuries to the body are associated with blunt trauma to transverse colon. Injuries to tail of pancreas are associated with injury to the spleen. Associated organ injuries to pancreatic injuries are frequent in liver, stomach, vascular system, small bowel and colon, spleen, kidney, duodenum and biliary tract on descending order.

Mechanism of injury: blunt pancreatic injuries occur when high energy crushing force is applied to the upper abdomen.

The majority of blunt pancreatic injuries result from motor vehicle accidents.

The energy of impact is usually directed at the epigastrium or hypochondrium, resulting in a crushing of the retroperitoneal structures. At least 60% of blunt traumato the pancreas are due to the impact of the vehicle steering wheel, eventhough any high energy blowinepigastric region can injure the pancreatic parenchyma.

Epigastric pain out of proportion to the abdominal examination is often a clue to a retroperitoneal injury. Following is the commonly used method of classification of pancreatic injuries.

Diagnosis:

Most patients with injuries to the retroperitoneal pancreas will have minimal clinical symptoms and signs when seen first after trauma; reason for this is the retroperitoneal location of the organ which masks the early development of peritonitis. Secondly, tamponading effect ofretroperitoneum may prevent significant blood loss from pancreatic injury.

Thus symptoms may be absent for 12 hours. Severe epigastric pain out of proportion to the clinical features may indicate pancreatic injury.

Computed tomography:

May provide direct information about the location of

pancreatic injuries as well as providing 3 dimensional picture of the wound. However pancreatic injuries may be missed. Diagnostic peritoneal lavage will show negative results since pancreas is retroperitoneal.

Laparotomy: The single most reliable means of making the diagnosis of pancreatic injuries.

Kidney and Suprarenal:

The more common sign in patients with traumatic damageto the genitourinary path is hematuria.

The degree of hematuria does not correlate with the brunt of injury, radiographic evaluation has been recommended in every trauma patients who has hematuria. However, the large no of renal injuries is minor and is managed non operatively.

Thus, cost and morbidity from adverse decisions could be avoided if radiographic investigations were limited to a group of induviduals more likely to have major injury, those with either gross -hematuria or microscopic -hematuria and shock.

A kidney contusion is seen as an area of pooropacified renal parenchyma. Since a kidney laceration extends to the surface of the kidney, a sub-capsular or perirenal hematoma will be present.

If the kidney contour is flattened by the compressed force of ahematoma contained by an intact kidney capsule, a sub-capsular hematoma can be identified. If the capsule has been breached, the fluid runs away from the renal area producing a peri-nephric hematoma.

Arterial injuy can be found by CECT if they cause renal -infarction or if active extravasation is demonstrated. The infarcted area of renal parenchyma does not have enhancement with intra-venous contrast injection. However, a thin rim of enhanced kidney can be detected if the kidney capsular vessels remain uninjured. Venous damage could result in either vessel laceration or thrombosis.

Lacerations often produce a large hematoma, but the source of the bleeding may not be apparent. The effect of renal venous thrombosis relies on the availability of collateral vessel.

If good collaterals are there, the renal parenchyma is unaffected. If there is poor collateral blood flow, the affectedrenal organ becomes swollen, edematous, and function decreases.

Avulsion of theuretero-pelvic junction is easily diagnosed on CECT by the extra-vasation of excreted contrastdye. Also hematoma is invariably present and other abdominal injury such as liver and splenic lacerations are common.

Hemorrhage: this is caused by rupture or pedicle injury: due to the tight gerota’s fascia, there is a tendency to limit the size of expansion of the hematoma. Some blood would inevitably escape through the pelvicalyceal system appearing as hematuria. Expanding hematoma also devitalizes small segments of lacerated kidney and cause infection. Eventually hematoma may undergo encapsulation and fibrosis.

Urinary leakage: whenever there is a rupture of kidney, urine may escape outside the renal capsule and form either diffuse extravasation or a localized collection calledUrinoma. If renal function is satisfactory, rupture is large or there is distal block then the urinoma keeps expanding.

- **Ischemic necrosis:** in pedicle injury, whole kidney may be ischemic; in rupture or shattered kidney, one or multiple segments may have blood supply compromised.

Expanding hematoma also tends to jeopardize blood supply to the small fragments.

Diagnosis:

History of trauma to the loin would be present inevitably. In case of blunt trauma to the abdomen or to the flank, exclusion of urinary tract injuries is essential. Loin pain is a significant finding in nearly all cases. Hematuria is the common presenting symptom, though in minor contusion, this may be microscopical.

Sometimes, due to intra-pelvic clotting, severe injury may have relatively small hematuria. Absence of hematuria does not exclude renal injury. 20% of patients with significant injury to the upper urinary tract do not have hematuria.

Onset of loin pain, fullness over renal area, increasing abdominal girth, ileus,ecchymosis over flanks due to associated intra abdominal injury or hematuria and unexplainedhemodynamic instability or fracture of 10,11,12 ribs following blunt abdominal trauma needto be investigated.

Investigations are done with two main purposes. Firstly, to evaluate and stage the injury, and secondly, to see for the presence and functional status of kidney on the other side.

Urinalysis and Ultrasonography along with isotope study are useful preliminary screening procedures. Intravenous urography (IVU) with high dose infusion nephrotomography demarcates renal outlines with or without extravasation or renal laceration.

Ultrasonogram: is of value in detecting pre-existing or developing hydronephrosis,

urinoma and para-renal pseudohydronephrosis. It is indicated early in cases of non functioning kidney (on IVU) to detect parenchymatous state and site of hematoma- intra renal or pre-renal.

Computed tomography scan: is preferred modality of investigation for blunt injury. It provides better information of lacerations if present and blood collection within gerota's fascia.

Other organs of abdomen are also defined simultaneously. Small areas of infarct, 1cm are easily detected on CT scan. In contrast enhanced CT, renal infarcts are classically described as cortical rim sign.

INTESTINAL INJURIES :

XRAY CHEST ABDOMEN :air under diaphragm may be present.

FAST(FOCUSSED ABDOMINAL SONOGRAPHY IN TRAUMA):

Free fluid in the peritoneum may be present.

CECT(CONTRAST ENHANCED COMPUTERISED TOMOGRAPHY):

Detects free fluid ,airloculated anywhere in the peritoneal cavity.

Retroperitoneal colon injury may be missed.

CONCLUSIONS

CONCLUSIONS

Following conclusions can be drawn from our study:

CECT is the gold standard technique for evaluating of blunt injury patients because it is highly sensitive and panoramic compared with FAST

FAST(USG) is widely available largely used as the preferred screening tool in many trauma centers,FAST has been observed as a valuable primary imaging technique because it is rapid ,noninvasive, can be used on bedside of the patient, and it was found not to interrupt resuscitation efforts. FAST(USG) easily repeatable and less expensive.

FAST has proven to be reliable in evaluating the presence of free intra-peritoneal fluid. **A literature reveals that FAST(USG) is an excellent tool for visualization of hemoperitoneum, with a sensitivity of 63-99%** . The main limitation is its poor ability to depict parenchymal lesions.

The value of FAST in revealing an organ injury varies greatly according to the lesion located. In the detection of spleen injuries, the sensitivity ranges from 27% to 68.6%. The bigger size of the liver and easier approach implies the higher sensitivity of FAST for lesion of liver, ranging from 51% to 87.5% in variousstudies. For renal orsupra renal injuries, however, FAST has a low sensitivity (25-40%)

FAST is foundto be diagnostic tool initially to detect intraabdominal fluid in abdominal trauma. With proper training and under-standing the limitations of ultra-sound, optimization of the results of FAST is obtained.

In haemo-dynamically stable patients the diagnostic modality of choice is CECT with intravenous contrast. It is found to be of usein detecting free air and intra-peritoneal fluid, grade the extent of solid viscera injury, detect retroperitoneal organ injury, and helps in the decision for aconservative management. Helical CECT is done rapidly which decreases the time the patient stays in the CECT scan room. Furthermore, CECT improves the sagittal and coronal reconstruction views which are of use for detecting a ruptured diaphragm.

Blunt injury abdomen with solid organ injury forms considerable load of patients in our society.

Most common age group involved is 31-40 years. Predominantly males are affected in large proportions.

Road traffic accident forms the most common mode of injury. So efforts should be made to bring road traffic regulations into strict action and traffic norms regulated.

Well established trauma care centres should be established at every Taluk hospital. Measures for early transport of the patients from the accident site to the trauma centres should be undertaken.

Clinical presentation is varied, sometimes confusing.

Erect abdomen X ray is a useful investigation to identify associated hollow viscus injury.

we have observed FAST as adjunct to the initial evaluation of blunt injury patients.

Those with a +ve FAST are at risk for significant abdominal bleeding that iscritical and likely to need laparotomy sooner.

Resource might then be mobilized appropriately and injury care hopefully revolutionised.

Therefore, FAST is found useful in the early decision making whether the patient needs immediate laparotomy to control the bleeding.

Those with a -ve FAST are not atsignificant risk for bleeding and can be imaged by CECT in a less urgent manner.

A particular minority of patients can-not be evaluated by FAST, and, in those patients, other clinical investigations must be followed to decide treatment.

Additionally, FAST performed by the surgeon, as is so in our experience, should only be used as a screening mode for bleeding and mightnot supplant a CECT scan as a definitive imaging mode for intra-abdominal trauma.

With the advent of high resolution ultrasonography (FAST) DPL and FQA investigations are becoming less opted.

CECT forms the core investigation of choice in dealing with blunt injury abdomen patients.

In conclusion FAST can be done in all blunt injury abdomen patients and the need for laparotomy assessed as it detect solid organ injuries with sensitivity reaching 98% from our study.

If the patient is stable then further imaging by CECT can be done.

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LIST OF ABBREVATIONS USED

BIA – Blunt injury abdomen

CBD - Common bile duct

CECT – Contrast enhanced computed tomography

CHD - Common hepatic duct

CPR - Cardiopulmonary resuscitation

CVP - Central venous pressure

ERCP - Endoscopic retrograde cholangiopancreatography

FAST – Focused assessment by sonography for traum

GCS - Glasgow coma scale

ICU - Intensive care unit

IVC - Inferior venacava

IVU – Intravenous Urography

KUB - Kidney, ureter, bladder x ray film

MRI - Magnetic resonance imaging

RTA – Road traffic accident

USG – Ultrasonography

LIST OF TABLES

LIST OF FIGURES

Blunt trauma Abdomen

P R O F O R M A

Patient details:

Name: Age:

I P no: Unit:

Injury on: Admission on:

Operated on: Discharged on:

Expired on:

Presenting complaints:

Mode: of Injury: Time: Place:

- Road Traffic Accident
- Assault
- Fall

Events that followed:

History of present illness:

Any other complaints:

Previous history:

Personal history:

EXAMINATION:

General physical examination:

PER ABDOMEN EXAMINATION :

Inspection :

Palpation:

Percussion:

Auscultation:

External genitalia:

Per rectal findings:

Systemic examination:

Respiratory system :

Cardiovascular system :

Central nervous system :

Provisional Diagnosis:

Investigations:

BLOOD GROUPING AND TYPING

COMPLETE BLOOD CONT

RENAL FUNCTION TEST

SERUM:

Amylase

X ray:

Erect Abdomen:

Chest

Pelvis

Spine

FAST:

CECT SCAN abdomen:

Management: fluids given:Blood transfusion:

OPERATIVE NOTES:

Date

Started ended

Anesthesia

Operative findings

Final diagnosis:

RESEARCH NO.	NAME	AGE/ SEX	IP.NO	MODE OF INJURY	ON ADMISSION		POST RESUSCITATION		Xray Chest/ Abd Erect	FAST findings	CECT findings	Operative findings
					PULSE	SBP	PULSE	SBP				
01	ARAVIND	46/ M	71546	RTA	105	60	110	70	NAD	+ve left hypochondrium	Splenic injury grade 3	Splenic laceration
02	KIRAN KUMAR	37/ M	71689	RTA	88	130	86	130	NAD	+ve left hypochondrium	Splenic injury grade 2	Splenic laceration
03	VINAYAGAM	40/ M	71950	RTA	86	130	88	140	Grd Glass	+ve right hypochondrium pelvis	Liver injury grade 2	Liver laceration/mesenteric tear
04	SYED THURAH	45/ M	71707	RTA	92	110	96	110	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
05	SEKAR	56/ M	71961	RTA	110	60	120	60	NAD	+ve right hypochondrium	Liver injury grade 2	Liver laceration
06	RAMACHANDRAN	54/ M	71997	FALL	78	140	88	130	Grd Glas	+ve right hypochondrium	Liver injury grade 3 Right renal injury	Liver laceration/ right renal contusion

									s			
07	EJAZ ALI	23/ M	7408 0	RTA	100	11 0	96	110	Grd Glas s	+ve left hypochondrium &pelvis	Splenic injury grade4	Splenic laceration
08	ENAMUL	35/ M	7413 7	RTA	96	12 0	98	110	Grd Glas s	+ve right hypochondrium	Liver injury grade 3	Liver laceration
09	KUMARI	55/ F	7416 5	FALL	80	13 0	88	130	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
10	ALAGESAN	51/ M	7417 4	RTA	100	90	110	80	AUD	+ve left hypochondrium	Splenic injury grade3/ hollow viscus perforation	Splenic laceration/ Jejunal perforation
11	KANNAN	36/ M	7633 0	RTA	90	11 0	88	130	NAD	+ve right hypochondrium	Liver injury grade 3	Liver laceration
12	KRISHNAN	72/ M	7635 5	RTA	110	70	120	60	NAD	+ve left hypochondrium	Splenic injury grade2/ Left renal injury grade 5	Left ranalavulasion with shattering/spleni c laceration
13	KAMALAKAN NAN	46/ M	7854 7	RTA	88	13 0	84	130	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration

14	VINOTH KUMAR	23/ M	7880 0	RTA	82	12 0	86	130	NAD	+ve right hypochondrium	Liver injury grade 2	Liver laceration
15	LAILA	60/ F	8111 3	FALL	84	13 0	86	130	NAD	+ve pelvis	Bladder injury	Intraperitoneal bladder rupture
16	ANBU	19/ M	8117 1	RTA	92	11 0	90	120	NAD	+ve left hypochondrium/ pelvis	Splenic injury grade3	Splenic laceration/ Mesenteric tear
17	BRITTO	16/ M	8117 2	RTA	104	12 0	98	110	NAD	+ve right hypochondrium	Liver injury grade 2	Liver lacearation
18	JEEVA	32/ M	8367 6	RTA	80	13 0	88	130	AUD	--VE	Hollow viscusperforation	Duodenal perforation
19	VIMAL RAJ	22/ M	8603 6	RTA	92	11 0	84	140	NAD	+ve right hypochondrium	Liver injury grade 3	Liver laceratin 9x 4cm
20	INDRANI	50/ F	8604 0	RTA	90	14 0	86	130	NAD	+ve left hypochondrium	Splenic injury grade2	Splenic laceration
21	MANIKANDA N	28/ M	8837 9	RTA	88	13 0	84	120	Grd Glas s	+ve left hypochondrium	splenic injury grade 4	Splenic injury /distal pancreatic injury
22	ANBARASAN	36/ M	8838 4	RTA	96	11 0	92	110	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic injury
23	LEO JOHN	26/ M	8839 3	RTA	88	13 0	90	120	NAD	+ve Morrison pouch	Right renal contusion/	Right renal contusion/mesen

											hemoperitonium	tric rent
24	RAJKUMAR	38/ M	8843 8	RTA	84	13 0	86	130	NAD	+ve right hypochondrium	Liver injury grade 3	Liver laceration
25	KADIRVEL	32/ M	9108 2	RTA	100	60	100	60	Grd Glas s	+ve left hypochondrium	Splenic injury grade4	Splenic laceration/mese nteric tear
26	CHINNA DURAI	45/ M	9108 7	FALL	86	13 0	90	120	NAD	+ve right hypochondrium	Liver injury grade 2	Liver laceration
27	BHARATHI	48/ M	9332 6	RTA	110	70	110	70	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
28	MUNI PUSHPA	42/ F	9341 7	RTA	80	14 0	90	120	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
29	PRAVEEN	23/ M	9343 2	RTA	82	13 0	88	130	NAD	+ve right hypochondrium	Liver injury grade 2	Liver laceration
30	VENKATESH	32/ M	9343 3	RTA	86	13 0	90	110	AUD	+ve pelvis	Hollow viscus perforation/hemoper itonium	Jejunal perforation/mes enteric rent
31	MUNUSAMY	45/ M	9345 1	FALL	100	80	120	80	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
32	MOHAN	29/ M	9577 1	RTA	92	12 0	90	140	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
33	POONGODI	29/	9598	RTA	94	11	96	110	Grd	+ve right	Liver injury grade 3	Liver laceration

		F	2			0			Glas s	hypochondrium		
34	KARUNANITHI	46/ M	9858 8	RTA	88	13 0	84	130	NAD	+ve Morrison pouch	Right renal contusion/ hemoperitonium	Right renal contusion/ Mesenteric tear
35	PRAKASH	45/ M	9862 0	FALL	82	13 0	80	120	NAD	+ve right hypochondrium	Liver injury grade 3	Liver laceration
36	RAVIKUMAR	27/ M	9864 9	RTA	80	14 0	88	130	NAD	+ve right hypochondrium	Liver injury grade 2	Liver laceration
37	JAYARAJ	35/ M	9866 2	RTA	120	70	110	80	Grd Glas s	+ve left hypochondrium/ pelvis	Splenic injury grade 4/ Intraperitoneal bladder injury	Splenic laceration/ Intraperitoneal rupture of bladder
38	BALU	40/ M	1006 89	RTA	84	13 0	86	130	NAD	+ve Morrison pouch	Right renal laceration grade 4	Right renal laceration
39	AJITH KUMAR	36/ M	1006 82	RTA	110	60	120	70	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
40	KRISHNAVENI	45/ F	1032 55	FALL	78	14 0	82	140	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
41	SANJAY	40/ M	1057 91	RTA	82	12 0	88	130	NAD	+ve right hypochondrium	Liver injury grade 2	Liver laceration

42	MANI	22/ M	1057 93	RTA	88	13 0	84	140	Grd Glas s	+ve left hypochondrium	Splenic injury grade4/left renal contution	Splenic laceration/left renal contusion
43	VASU	37/ M	1058 06	RTA	84	13 0	88	130	NAD	+ve Morrison pouch	Right renal laceration Grade 3	Right renal laceration
44	KANAGARAJ	22/ M	1058 29	RTA	92	12 0	96	110	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration
45	SARAVANAN	23/ M	1058 40	RTA	80	14 0	84	130	NAD	+ve Morrison pouch	Right renal laceration	Right renal laceration
46	BALAJI	28/ M	1077 63	RTA	86	13 0	88	130	NAD	+ve right hypochondrium	Liver injury grade 2	Liver laceration
47	SASIKUMAR	33/ M	1075 96	RTA	94	11 0	90	120	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration

48	ULAGAMOORTHY	45/M	118115	RTA	120	60	130	60	Grd Glass	+ve left hypochondrium/ pelvis	Splenic injury grade4/ Left renal laceration	Splenic laceration
49	SRIDHAR	38/M	118468	RTA	86	130	84	130	NAD	+ve right hypochondrium	Liver injury grade 2	Liver laceration
50	KAMBAKESWARAN	28/M	118995	RTA	92	120	96	110	NAD	+ve left hypochondrium	Splenic injury grade3	Splenic laceration

Key to master chart:

RTA-Road traffic accident ; SBP- systolic blood pressure; NAD- No abnormality detected; AUD –Air under the diaphragm; +ve – Positive;Abd erect- Abdomen erect